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THE

# VOYAGE OF H.M.S. CHALLENGER.

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ZOOLOGY—VOL. XVIII.

*SECOND PART.*

# REPORT

ON THE

## SCIENTIFIC RESULTS

OF THE

# VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

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UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND THE LATE

CAPTAIN FRANK TOURLE THOMSON, R.N.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH

DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY

ONE OF THE NATURALISTS OF THE EXPEDITION

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SECOND PART

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By ERNST HAECKEL, M.D., Ph.D., Professor of Zoology in the University of Jena.

SECOND PART.—OSCULOSA.

(NASSELLARIA AND PHÆODARIA.)

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## Legion III. NASSELLARIA,

## vel Monopylea, vel Monopylaria (Pls. 51–98)

*Nassellaria* (*inclusis* Spyridinis), Ehrenberg, 1875.
*Monopylea*, Hertwig, 1879.
*Monopylaria*, Haeckel, 1881.
*Cyrtida* et *Acanthodesmida*, Haeckel, 1862.

*Definition.*—Radiolaria with simple membrane of the central capsule, which is monaxon or bilateral, and bears on one pole of the main axis a porous area (porochora), forming the base of a peculiar intracapsular cone (podoconus). Extracapsulum without phæodium. Skeleton siliceous, very rarely wanting. Fundamental form originally monaxon, often dipleuric or bilateral.

The legion NASSELLARIA vel MONOPYLEA, in the extent here defined, was constituted in 1879 by Richard Hertwig in his work Der Organismus der Radiolarien (pp. 133–137). He gave to this large group the rank of an order, and united in it the two families Acanthodesmida and Cyrtida, which I had constituted first in 1862 in my Monograph (pp. 237, 265, 272); but he added, too, as a third family the Plagiacanthida, united by me with the former. In the first system of Ehrenberg (1847, *loc. cit.*, pp. 53, 54), four families belonging to the MONOPYLEA were enumerated, the Halicalyptrina, Lithochytrina, Eucyrtidina, and Spyridina. He united the three former under the name "Polycystina solitaria," which he afterwards changed into NASSELLARIA (1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 157).

In my Monograph of the Radiolaria (1862, pp. 265–345) forty-four genera of NASSELLARIA were enumerated (six Acanthodesmida and thirty-eight Cyrtida), whilst the total number of genera in the whole class of Radiolaria at that time amounted to one hundred and thirteen. But owing to the astonishing number of new and interesting forms of this legion which I afterwards detected in the collection of the Challenger, in 1881 I distinguished in my Prodromus not less than three hundred and seventeen genera. These were disposed in five large main groups, retained in the present Report, with twenty-six families, viz., (1) Plectoidea (with three families), (2) Stephoidea (with four families), (3) Spyroidea (with four families), (4) Botryodea (with three families), and (5) Cyrtoidea (with twelve families). The first two groups have an incomplete or rudimentary skeleton, and may be united in the order Plectellaria, whilst the other three families possess a complete latticed shell, and

may be united as Cyrtellaria. The former correspond to the Acanthodesmida, the latter to the Cyrtida in my Monograph.

The character common to all MONOPYLEA or NASSELLARIA, which separates them from all other Radiolaria, was first recognised by Richard Hertwig in 1879, and consists in the singular structure of the monaxonian central capsule, bearing on the basal pole a peculiar porous area or operculum, the "Porenfeld;" we call it shortly the "porochora." It represents a circular or elliptical porous plate on the basal pole of the vertical main axis of the central capsule, and bears a peculiar "podoconus" or "Pseudopodien-Kegel," a conical body of singular structure, protruding inside the membrane into the capsule. The pseudopodia arising from this peculiar "podoconus" proceed from the capsule piercing the "porochora," whilst the other parts of the capsule are not perforated.

The MONOPYLEA are therefore "Merotrypasta," like the following fourth legion, the PHÆODARIA or CANNOPYLEA. But in these latter we find on the basal pole of the monaxonian capsule only one single large main opening, prolonged into a peculiar tube, and there is no trace of the typical "podoconus," characteristic of all NASSELLARIA. The latter agree, however, with the former in the possession of a basal opening, serving for the emission of the pseudopodia, and in the monaxonian fundamental form, arising from this structure. Therefore these two legions of "Merotrypasta" exhibit a wider divergence from the ACANTHARIA and SPUMELLARIA, the two legions of "Holotrypasta," in which the central capsule is everywhere perforated by innumerable small pores (compare above, pp. 5, 6, 716).

*The Skeleton* in all NASSELLARIA consists either of pure silica, or of a peculiar silicate; never of acanthin (as in all ACANTHARIA). The siliceous bars and beams constituting it are invariably solid (as also in the SPUMELLARIA); never hollow (as in the PHÆODARIA). In the small family of Nassellida alone (with the two genera *Cystidium* and *Nassella*) the skeleton is entirely absent. In all other genera of NASSELLARIA the siliceous skeleton is more or less developed; imperfect, or quite rudimentary in the Plectellaria (Plectoidea and Stephoidea), but perfect and forming a regular lattice-shell in the Cyrtellaria (Spyroidea, Botryodea, and Cyrtoidea). The different forms of this skeleton exhibit an extraordinary variety, but may be reduced to a few very simple fundamental forms, or even to a single, most simple original form. The comparative morphology is more interesting, but also more difficult to understand than in any other Radiolaria.

The geometrical fundamental form of the skeleton is in all NASSELLARIA monaxonial, the vertical main axis of the body, which is already indicated by the axis of the central capsule with two different poles, being also expressed constantly in the form of the skeleton. The lower or basal pole of the latter always exhibits a different shape from that of the upper or apical pole. This difference is so striking in nearly all MONOPYLEA, that the two poles may be determined on the first view.

In the great majority of NASSELLARIA not only is the monaxonial fundamental form expressed, but also the dipleuric or bilateral, so that the symmetrical halves of the body may be easily determined; the right and left halves exhibit the same symmetry as in the vertebrates, so that we may distinguish an anterior ventral and a posterior dorsal face of the body. The whole form is in this case determined by three dimensive axes, perpendicular to one another, two of which are heteropolar, the third is homœopolar. The apical pole of the vertical main axis (principal or longitudinal axis) is different from the basal pole. The ventral pole of the horizontal sagittal axis (or dorso-ventral axis) is different from the dorsal pole. The right pole of the horizontal transverse axis (lateral or frontal axis) is equal to the left pole. Therefore the sagittal or median plane of the body (in which the principal and the sagittal axis are crossed) divides it into symmetrical equal halves and is perpendicular to the frontal axis.

Three different original elements of structure are recognisable in the majority of NASSELLARIA, viz., (1) a vertical simple ring, the primary or sagittal ring, placed vertically in the sagittal plane and enclosing the median plane of the central capsule; (2) a basal tripod, composed of three diverging radial rods, which are united on the basal pole of the central capsule and are either expanded horizontally or descend; (3) an ovate or subspherical, simple lattice-shell, the cephalis or capitulum, which surrounds the central capsule and exhibits a peculiar structure on its basal pole.

These three important original elements of structure—the sagittal ring, the basal tripod, and the latticed cephalis—are so united in the majority of NASSELLARIA that the cephalis rests upon the tripod and includes the sagittal ring wholly or partially. The simplest realisation of this typical union is afforded by the Archiperida and Tripospyrida, and these may be derived from the simpler important Stephanid *Cortina* (Pl. 83, fig. 9; Pl. 92, fig. 21; Pl. 97, fig. 1). In this and in all other tripodal NASSELLARIA, the three basal rods or the "cortinar feet" are constantly so arranged that an odd or posterior rod, the "caudal foot" (*c*) is opposed to the two anterior paired rods, the "pectoral feet" (one right, *p''*, and one left, *p'*). The caudal foot lies in the sagittal plane, and is prolonged upwards into the dorsal rod of the sagittal ring (*b*), and over this in a free ascending spine, the "apical horn" (*a*). The curved ventral rod of the ring (*r*) is united above with the base of the apical horn, below with the common centre of the tripod or the "cortinar centrum." The characteristic position of the central capsule in this skeleton of *Cortina* is such that its basal pole (with the porochora) rests upon the centre of the tripod, whilst its sagittal perimeter is separated from the surrounding ring by the calymma; the numerous pseudopodia arising from its base diverge downwards and are supported and protected by the three basal feet of the tripod (Pl. 97, fig. 1). Compare also Pls. 51, 53, 84, 95, 98.

The typical skeleton of *Cortina*, a tripodal ring, becomes more developed in the Semantid *Cortiniscus*, in which the basal parts of the three diverging feet are united

by a second horizontal ring, the cortinar or basal ring (Pl. 92, figs. 11–13). The pores between the former and the latter, or the "cortinar pores," may be regarded as the first beginning of the lattice-plate, composing the "cephalis" or the simple primordial shell in the Archiperida and Tripospyrida, and transmitted from these by heredity to the great majority of NASSELLARIA.

The "cephalis or capitulum" (the "Köpfchen" of the German authors) is therefore the most important part of the skeleton in all Cyrtellaria, or in all NASSELLARIA possessing a complete lattice-shell. In the Plectellaria, however, or in those NASSELLARIA which do not possess a complete fenestrated shell, the "cephalis" is either imperfect or totally wanting. The cephalis surrounds the enclosed central capsule on all sides in the form of an ovate or subspherical lattice-shell, and is separated from it only by the jelly-like calymma. The sagittal ring is either enclosed in the wall of the cephalis (wholly or partially), separating its two lateral halves, or it is enclosed in the cavity of the cephalis and connected with its sagittal perimeter by short beams. The base of the cephalis (with the cortinar plate) often rests immediately upon the centre of the tripod; in the majority of NASSELLARIA, however, this near relation is altered by reason of later changes and secondary modifications.

The number of various forms, developed from these simple original structural elements of the skeleton, is astonishing, and there are described more than three hundred genera and nearly two thousand species of this legion in the following pages. This large number may be easily increased by subsequent observers. Since in all these MONOPYLEA the characteristic structure of the central capsule is identical, and also the structural elements of the siliceous skeleton are similar, it is very probable that they may have arisen from a single common stock. But it is very difficult (and at present impossible) to explain a natural monophyletic system of this large legion. The greatest difficulty is presented by the fact that the three structural elements mentioned above, viz., the sagittal ring, the basal tripod, and the latticed cephalis, are not constantly united, but each alone may also constitute the skeleton by itself. In this respect the following seven cases are possible, and are actually realised.

A. The skeleton is composed of the sagittal ring only and of its spiny appendages, without basal tripod and without latticed cephalis. This is the case in the majority of Stephoidea (Stephanida, Semantida, Coronida, and Tympanida).

B. The skeleton is composed of a basal tripod only (*Plagiacantha*), or of a tripod in the centre of which arises a vertical apical horn (*Plagoniscus*), and often of an irregular framework, arising from the rods of the tripod; but there is neither a trace of a sagittal ring nor a complete latticed cephalis. This is the case in the remarkable suborder Plectoidea (Plagonida and Plectanida).

C. The skeleton is composed of a latticed cephalis only, a simple ovate or subspherical fenestrated shell, which encloses the monopylean central capsule; there is no

trace of a sagittal ring nor of a basal tripod. This is the case in the remarkable family of Cyrtocalpida (Archiocorida and Archicapsida), in numerous Botryodea and in other Cyrtellaria.

D. The skeleton is composed of a sagittal ring and a basal tripod, without latticed cephalis. This is the case in a few, but very important forms of Stephoidea: *Cortina, Stephanium, Cortiniscus, Stephaniscus, Podocoronis,* and some allied genera.

E. The skeleton is composed of a sagittal ring and a latticed cephalis, but without basal tripod. This is the case in numerous Cyrtellaria, in the Circospyrida (or Zygospyrida apoda: *Dictyospyris, Circospyris*) and some other Spyroidea; and in a large number of Botryodea and Cyrtoidea eradiata (a part of the Sethocyrtida, Theocyrtida, Lithocampida, and others).

F. The shell is composed of a basal tripod and a latticed cephalis, but without any trace of the sagittal ring. This is the case in numerous Cyrtoidea triradiata and multiradiata, and perhaps in the majority of the following families — Tripocalpida, Tripocyrtida, Podocyrtida, and Podocampida.

G. The shell is composed of all three above-mentioned elements, of a sagittal ring, a basal tripod, and a latticed cephalis. This is the case in the great majority of Spyroidea (with a few exceptions only), and perhaps also in the majority of Cyrtoidea.

The survey of these seven groups, A to G, each of which is represented by numerous living forms, shows clearly how difficult and complicated the morphology and phylogeny of the numerous NASSELLARIA must be. For all possible combinations of the three original structural elements are realised abundantly, and in such complicated relations, and so intermingled in the different orders and families, that it seems nearly hopeless to answer the question of their true origin. The identity in the structure of the central capsule, however, in all these MONOPYLEA, makes it probable that they have all arisen originally from the skeletonless Nassellida (*Cystidium, Nassella*), either in a monophyletic or in a polyphyletic way. In this respect the following phylogenetical hypotheses are possible.

1. Monophyletic hypothesis, deriving all NASSELLARIA from a simple sagittal ring (*Archicircus, Lithocircus,* &c., Pl. 81). The groups A, D, E, and G may be derived easily from such a ring, but the groups B, C, and F only by means of the hypothesis that the original ring may be completely reduced and finally lost. This hypothesis was stated by me in the years 1877 to 1879, when I had got the first general survey of the astonishing number of new NASSELLARIA in the Challenger collection, and as I had found the sagittal ring in the majority of them. This, my former hypothesis, is mentioned by Richard Hertwig (1879, *loc. cit.,* pp. 68, 126). It was afterwards supported with particular energy by O. Bütschli (1882, Zeitschr. für wiss. Zool., Bd. XXXVI.).

2. Monophyletic hypothesis, deriving all NASSELLARIA from a basal tripod (*Triplagia, Plagoniscus,* &c., Pl. 91). The groups B, D, F, and G, all triradiate, may

be derived easily from such a tripod; but the groups A, C, and E only by means of the hypothesis that the original tripod may be completely reduced and finally lost. This hypothesis was employed in 1881 in my Prodromus, since I had convinced myself that the "triradial structure" is prevalent in the great majority of NASSELLARIA, and is perhaps more important than the sagittal ring.

3. Monophyletic hypothesis, deriving all NASSELLARIA from a latticed cephalis, a simple ovate or subspherical fenestrated shell without ring and tripod (*Cyrtocalpis, Archicapsa*, &c.). The groups C, E, F, and G may be derived easily from such a cephalis, but the groups A, B, and D only by means of the hypothesis that the sagittal ring as well as the basal tripod may remain as the last remnants of a reduced cephalis. This hypothesis was given in 1862 in my Monograph, where I constructed the first pedigree of Radiolaria (p. 234). I there derived all the Cyrtida from the Sphæroidea (*Cyrtidosphæra*), supposing that *Cyrtocalpis* and some other Monocyrtida may form a direct phylogenetical passage from the Sphæroidea to the Cyrtoidea.

4. Polyphyletic hypotheses, deriving the different groups of NASSELLARIA from different skeletonless Nassellida, by development of simple siliceous skeletons in different ways. Among the numerous polyphyletic hypotheses which are possible, one of the simplest would be the supposition that three different fundamental forms of skeleton may have arisen independently one from another: (1) a simple sagittal ring as original form of the Stephoidea and Spyroidea (A); (2) a simple basal tripod as original form of the Plectoidea (B); (3) a simple latticed cephalis as original form of the Botryodea and Cyrtoidea (C). This triphyletic hypothesis is supported by R. Hertwig (1879, *loc. cit.*, p. 136); he assumes that the original skeletonless Nassellida (*Cystidium*) have produced three different branches, his "Acanthodesmida" (=Stephoidea and Spyroidea) with a primary ring, his "Plagiacanthida" (=Plectoidea) with a primary tripod, and his Cyrtida (=Botryodea and Cyrtoidea) with a primary cephalis. This hypothesis seems rather probable on the first view; but it meets with the greatest difficulties in view of the fact that these three original elements of the skeleton are more or less evidently combined in the great majority of NASSELLARIA. The greatest difficulty arises from the fact that often among very similar and closely allied forms the first exhibits all three elements (A, B, C) combined, whilst the second has a combination of A and B, the third of B and C, the fourth of A and C; and there are other forms, very similar to the former, in which one element only is recognisable. Another difficulty arises from the fact that the intimate structure of the cephalis in the majority of Cyrtellaria is not perfectly known, and often exhibits structures which are difficult to explain with regard to the three elements A, B, C. Under these circumstances further researches on the numerous imperfectly known NASSELLARIA are required, and chiefly accurate observations on their more minute structure and on their important ontogeny.

We divide the immense legion of NASSELLARIA into two large orders, the Plectellaria without complete lattice-shell, and the Cyrtellaria with a complete lattice-shell or a "cephalis," including the central capsule; the latter, of course, have arisen from the former. The Plectellaria comprise three different suborders, the Nassoidea (without skeleton), the Plectoidea (with a tripodal skeleton, without ring), and the Stephoidea (with a primary sagittal ring, with or without tripod). The Cyrtellaria again also comprise three different suborders, the Spyroidea (with bilocular cephalis and a sagittal constriction), the Botryodea (with multilocular and lobate cephalis, exhibiting two or more constrictions and three or more lobes), and the Cyrtoidea (with simple, unilocular cephalis, without constriction).

*Synopsis of the Orders and Suborders of* NASSELLARIA.

| | | |
|---|---|---|
| I. Order PLECTELLARIA. Nassellaria without complete lattice-shell. | No skeleton, | 1. Nassoidea. |
| | Skeleton with a basal tripod, without ring, | 2. Plectoidea. |
| | Skeleton with a sagittal ring (usually without tripod), | 3. Stephoidea. |
| II. Order CYRTELLARIA. Nassellaria with a complete lattice-shell. | Cephalis bilocular, with a sagittal constriction, | 4. Spyroidea. |
| | Cephalis multilocular, with two or more constrictions and lobes, | 5. Botryodea. |
| | Cephalis simple, without constriction and lobes, | 6. Cyrtoidea. |

## Order V. PLECTELLARIA, Haeckel, 1883.

*Definition.*—NASSELLARIA without complete lattice-shell, usually with an incomplete skeleton, formed of a ring, a tripod, or an irregular framework.

### Suborder I. NASSOIDEA, Haeckel.

*Definition.*—NASSELLARIA without skeleton. Single family Nassellida.

## Family XLV. NASSELLIDA, Haeckel.

*Cystidina*, Haeckel, 1883, Sitzungsb. Jena Ges. für Naturw., Februar 16.

*Definition.*—NASSELLARIA without skeleton. The soft body composed of a monopylean central capsule (with porochora and podoconus) and of a surrounding jelly-veil or calymma.

The family Nassellida comprises the simplest and most primitive forms of NASSELLARIA, the only group which is entirely without a skeleton. The central capsule is therefore perfectly free and naked, enveloped by the calymma only, as in the Colloidea among the SPUMELLARIA, in the Phæodinida among the PHÆODARIA. Probably these naked and skeletonless MONOPYLEA must be regarded as surviving remnants of the common ancestral group of this legion; but the possibility is not excluded that the few observed forms are either young NASSELLARIA which have not yet secreted a skeleton, or older NASSELLARIA which have lost their original skeleton.

We distinguish in this small family two genera only: *Cystidium* with hyaline, not foamy calymma, without extracapsular alveoles, and *Nassella*, with a very voluminous foamy calymma, including numerous large alveoles; the former corresponds to *Actissa* and the latter to *Thalassicolla* among the Colloidea or the skeletonless SPUMELLARIA. But in these two latter genera, as in all PERIPYLEA, the central capsule is perforated everywhere by innumerable small pores; the two former genera, however, exhibit the same characteristic podoconus in the central capsule, and the same porochora at its base, as all the other MONOPYLEA. The pseudopodia are protruded from the central capsule through the porochora only.

*The Central Capsule* is in the two observed genera either ovate or nearly spherical, usually slightly tapering towards the basal mouth. Its transverse section is constantly circular. The membrane of the capsule is usually rather thick and double-contoured, and bears on the truncate basal pole a circular "porochora" or area porosa, through which the pseudopodia are protruded. The *porochora* is either quite simple, circular, or in some species trilobed, with three equal circular lobes, each of which is surrounded by a girdle of small granules. The *podoconus*, or "pseudopodial-cone," arising vertically from the horizontal basal porochora, is half as long as the central capsule, or longer, simply conical and finely striped longitudinally. The *nucleus* lies usually in the uppermost part of the central capsule, above or behind the podoconus, and is either spherical or ovate, sometimes kidney-shaped. It includes one or more nucleoli.

### *Synopsis of the Genera of Nassellida.*

| | |
|---|---|
| Calymma hyaline, without alveoles, | 382. *Cystidium.* |
| Calymma foamy, with numerous large alveoles, | 383. *Nassella.* |

Genus 382. *Cystidium*,[1] R. Hertwig, 1879, Organismus d. Radiol., p. 87.

*Definition.*—Nassellida with hyaline calymma, without extracapsular alveoles.

The genus *Cystidium* is the simplest and most primitive among all NASSELLARIA, and may be regarded as the common ancestral form of this legion, for which it has the same high importance as *Actissa* for the SPUMELLARIA. The central capsule is quite simple, ovate or nearly spherical, and included in a voluminous hyaline calymma, which contains no large alveoles. *Cystidium* differs from *Actissa*, its probable ancestral form, in the possession of the "podoconus" and its basal "porochora," characteristic of all NASSELLARIA or MONOPYLEA.

1. *Cystidium princeps*, n. sp. (Pl. 91, fig. 1).

Central capsule ovate, one and a third times as long as broad. Podoconus with simple circular porochora, about half as long as the capsule, surrounded at its base by red granules of pigment. Nucleus spherical. Three equal oil-globules in the endoplasm. No pigment in the voluminous calymma, which includes numerous xanthellæ.

*Dimensions.*—Length of the central capsule 0·1, breadth 0·075; nucleus 0·035.

*Habitat.*—Indian Ocean, Maldive Islands (Haeckel), surface.

2. *Cystidium lecythium*, n. sp.

Central capsule ovate, one and a half times as long as broad. Podoconus with simple circular porochora, three-fourths as long as the capsule. Nucleus ellipsoidal. No oil-globules in the endoplasm. No pigment and no xanthellæ in the calymma.

*Dimensions.*—Length of the central capsule 0·12, breadth 0·08; nucleus 0·04.

*Habitat.*—Central Pacific, Station 271, surface.

3. *Cystidium inerme*, R. Hertwig.

*Cystidium inerme*, R. Hertwig, 1879, Organismus d. Radiol., p. 87, Taf. vii. figs. 1–1*b*.

Central capsule subspherical, a little longer than broad. Podoconus about two-thirds as long as the capsule, with trifid porochora, which is composed of three equal circular lobes. Nucleus spherical. Numerous oil-globules in the endoplasm. The calymma includes numerous xanthellæ and brown pigment around the mouth.

*Dimensions.*—Length of the central capsule 0·06, breadth 0·05; nucleus 0·03.

*Habitat.*—Mediterranean, Messina (R. Hertwig), surface.

[1] *Cystidium*=Small vesicle; κυστίδιον.

Genus 383. *Nassella*,[1] nov. gen.

*Definition.*—Nassellida with foamy calymma, containing numerous large extracapsular alveoles.

The genus *Nassella* differs from the preceding *Cystidium*, its probable ancestral form, in the development of numerous large alveoles in the extracapsular calymma, and therefore exhibits the same relation to it that *Thalassicolla* bears to *Actissa* among the SPUMELLARIA. The foamy calymma is very voluminous, and includes numerous symbiotic xanthellæ.

1. *Nassella thalassicolla*, n. sp.

Central capsule spherical. Podoconus with simple circular porochora, half as long as the capsule. Nucleus spherical. Numerous oil-globules in the endoplasm. Calymma spherical, without pigment, with numerous xanthellæ and large alveoles.

*Dimensions.*—Diameter of the central capsule 0·12, nucleus 0·04, calymma 0·6.

*Habitat.*—South Pacific, Station 300 (off Juan Fernandez), surface.

2. *Nassella nassiterna*, n. sp.

Central capsule ovate. Podoconus two-thirds as long as the capsule, trifid, with three equal circular lobes (as in *Cystidium inerme*). Nucleus ovate. Three equal large oil-globules in the endoplasm, corresponding to the three lobes of the porochora. Calymma ovate, in the upper half much more voluminous than in the lower, including numerous large alveoli and xanthellæ, and around the mouth masses of black pigment.

*Dimensions.*—Diameter of the central capsule 0·1, nucleus 0·03, calymma 0·8.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

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Suborder II. PLECTOIDEA, Haeckel.

*Plectoidea* vel *Plectida*, Haeckel, 1881, Prodromus, p. 423.
*Plagiacanthida* (*sensu ampliori*), R. Hertwig, 1879, Organismus d. Radiol., p. 72.

*Definition.*—NASSELLARIA with a rudimentary, originally tripodal skeleton, composed of radial spines, arising from one common central point or central rod; the spines are simple or branched, and the branches may form by concrescence of their meeting ends a loose wickerwork, but never a complete lattice-shell. Never a ring in the skeleton.

[1] *Nassella* = Small wicker cage for fishing.

The suborder Plectoidea, hitherto known by few species only of "Plagiacanthida," comprises a large number of interesting NASSELLARIA, which belong partly to the simplest and most primitive forms of this legion. It may be divided into two different families, Plagonida and Plectanida. In the first family, Plagonida, the monopylean central capsule is supported by a simple or rudimentary skeleton, composed only of a variable number of radial spines united in a common centre. In the second family, Plectanida, the branches of these radial spines become united and form a loose irregular framework with wide meshes, partly enclosing the central capsule, but never a perfect lattice-shell.

The Plectoidea differ from the following suborder, the Stephoidea, in the absence of the ring, characteristic of the latter. Some slight traces, however, indicate a near affinity between the ringless Plectoidea and the ring-bearing Stephoidea. Both these suborders of Plectellaria differ from the closely allied Cyrtellaria (Spyroidea, Botryodea, and Cyrtoidea) in the absence of a complete lattice-shell. The morphological relation and phylogenetic affinity between the former and the latter have already been discussed in the preceding description of the legion NASSELLARIA (compare pp. 891–894).

The first known species of Plectoidea was observed in the North Atlantic (on the Norwegian shore) in 1855 by my late friend Edouard Claparède, and described and figured in his Études, &c. (1858), under the name *Plagiacantha arachnoides*. He considered it as a new genus of Acanthometrina. Another species, from the Mediterranean, was described in the same year by Johannes Müller as *Acanthodesmia dumetum* (1858, *loc. cit.*; Taf. i. fig. 3). A third species, also Mediterranean, was figured by me in 1865 under the name *Acanthodesmia polybrocha*. Finally, Richard Hertwig, 1879, in his Organismus der Radiolarien, gave a very accurate description of another Mediterranean form, *Plagiacantha abietina* (*loc. cit.*, Taf. vii. fig. 6). He first recognised the true character of MONOPYLEA in their monaxonian central capsule, and observed at the same time the first NASSELLARIUM without skeleton, called by him *Cyrtidium inerme* (*loc. cit.*, Taf. vii. fig. 1). To these four known species, representing three different genera, the rich collection of the Challenger has added so many new forms that we may distinguish here not less than seventeen genera and sixty-one species. In my Prodromus (1881, p. 423) I arranged these in two subfamilies, the Plagonida and Plectanida, constituting together the family Plectida (identical with the "Plagiacanthida" of Hertwig and Bütschli). But at present, regarding the important relations of these Plectida to the other NASSELLARIA, it seems more convenient to give to them the rank of an independent suborder of Radiolaria, under the name Plectoidea.

The peculiar structure of the central capsule of the Plectoidea, first recognised by Richard Hertwig, allows no doubt of their being true MONOPYLEA or NASSELLARIA; and also their siliceous, originally triradiate skeleton indicates the nearest affinity to

the other families of this legion. But a very difficult and as yet unsolved problem is the important question, in what manner these different groups of NASSELLARIA are phylogenetically connected. Either the Plectoidea—as the simplest of all—are the original common ancestral group of this whole legion (as I assumed in my Prodromus, 1881), or they are derived from the Stephoidea (by reduction of the sagittal ring), or they have originated independently from them (if we suppose a polyphyletic origin of the MONOPYLEA. Compare above, p. 893, &c.). In any case the typical "triradial structure" of the Plectoidea, prevalent also in the other groups of this legion, is a very important and interesting fact.

The triradial skeleton of the Plectoidea exhibits in the two families of Plagonida and Plectanida a complete homology of development, so that each genus of the latter may be derived from a corresponding genus of the former, simply arisen by concrescence or union of the branches of the radial spines. Therefore the only difference between the two closely allied families is, that the branches of the radial spines in the Plagonida remain free, whilst in the Plectanida they produce a loose framework or wickerwork by union of their meeting ends. We express this complete homology in the nomenclature of the Plectoidea, in each genus of Plagonida retaining the syllable "Plag-"; in each genus of Plectanida, correspondingly, the syllable "Plect-."

The number of radial spines composing the skeleton is originally three, and in all not triradial genera is probably derived from three. For better survey we may divide each family, according to the different number of rays, into four different subfamilies: A, with three radial spines (Triplagida and Triplectida); B, with four radial spines (Tetraplagida and Tetraplectida); C, with six radial spines (Hexaplagida and Hexaplectida); and D, with numerous (seven to nine or more) radial spines (Polyplagida and Polyplectida). The last three subfamilies have arisen probably from the first triradial subfamily, by a secondary increase in the number of rays.

The important signification of the triradial structure, recurring in the most different groups of NASSELLARIA, has been already pointed out sufficiently by myself and by R. Hertwig. But the triradial Plectoidea offer also another interesting relation of this characteristic structure, some simple forms of this order appearing nearly identical with the isolated triradial spicula of certain Beloidea (Thalassosphærida and Sphærozoida). Even some more complex quadriradial and sexradial forms of the latter reappear in exactly the same shape also in the former. This identity may be perhaps an important indication of true affinity (compare below).

The simplest and probably the most original kind of triradial structure is exhibited by the genera *Triplagia* and *Triplecta* (Pl. **91**, figs. 2, 7). Here three equal radial spines lie in one horizontal plane and are united in a common central point at equal angles, so that three lines connecting their distal ends form a regular equilateral triangle. Simple triradial spicula of the same regular form are also found in many

Beloidea (*Lampoxanthium, Sphærozoum,* &c., Pls. 2 and 4). The central capsule of these simplest Plectoidea (with vertical main axis) rests perpendicularly on the horizontal triangle, formed by the triradial skeleton; the porochora of the former (or the "area porosa") rests upon the central point of the latter.

Another kind of triradial structure characterises the genera *Plagiacantha* and *Plectophora*. The three radial spines united in the central point lie here not in one plane, but diverge in different planes, so that they correspond to the three lateral edges of a three-sided pyramid. Commonly the three spines are of equal size, and also the angles between them equal, so that the pyramid is regular, sometimes very flat, at other times more elevated. Spicula of exactly the same form are also found in some Beloidea. Probably the three divergent spines are homologous to the three basal feet of numerous Spyroidea and Cyrtoidea. The central capsule, according to Hertwig, is placed in the apical part of the pyramid, the axes of both being identical, and the porochora resting in the apex itself. This fact seems to contradict the above-mentioned affinity; but since in *Triplecta* and *Triplagia* the three spines lie horizontally, they may have changed this original position in different direction, in *Plagiacantha* and *Plectophora* becoming divergent upwards, whereas in *Plagoniscus* and *Plectaniscus* (as in the Spyroidea and Cyrtoidea) directed downwards.

The triradial structure, common to the Triplagida and Triplectida, is replaced by the quadriradial structure in the Tetraplagida and Tetraplectida. Probably the latter have been derived from the former by development of a fourth spine, and then this latter would correspond to the "apical horn" of the other NASSELLARIA. But possibly also both structures have originated independently from one another. We may distinguish not less than four different kinds of the quadriradial structure. In the first case all four spines are equal, and diverge from a common central point at equal angles in different directions, corresponding to the four axes of a regular tetrahedron (*Tetraplagia* and *Tetraplecta*, Pl. 91, figs. 3, 8).

In the second case all four spines are also equal, but they are not united in a common central point, but opposite in pairs on the two poles of a common central rod (*Plagonidium*). Therefore the skeleton possesses here the same form as in the "geminate-biradiate" spicula of many Beloidea (*e.g., Thalassoxanthium bifurcum* and *Sphærozoum furcatum*). The development of the short horizontal middle rod, connecting the two divergent pairs of spines, is here probably effected by the porochora of the central capsule resting upon it.

Whilst in these two cases of quadriradial structure all four spines are equal, in two other cases they become differentiated in a very remarkable manner. One spine is vertically directed upwards, in shape and size different from the three others, which are directed downwards; the former corresponding probably to the "apical horn," the latter to the three "basal feet," which are found in the great majority of the Spyroidea

and Cyrtoidea. Therefore we encounter here for the first time that characteristic "cortinar structure" which is complete in *Cortina* and *Cortiniscus* (Pl. 92, figs. 11–13, 21), and which may be regarded as the strongest argument for a close relationship, or even for a common monophyletic origin of all NASSELLARIA.

The four spines, which we regard therefore as "cortinar spines," exhibit a twofold kind of central junction. In the simpler case they are united in a common central point, on which rests the porochora of the central capsule (*Plagoniscus* and *Plectaniscus*, Pl. 91, figs. 4, 9). These forms are nearer to *Cortina*, and may be derived immediately from *Tetraplagia* and *Tetraplecta* by differentiation of the four equal spines. In the other case the four cortinar spines are separated in pairs, diverging from the two poles of a short horizontal common "central rod" (*Plagiocarpa* and *Periplecta*, Pl. 91, figs. 5, 10). These forms may be compared with the spicula of some Beloidea and derived from *Plagonidium;* but their basal central rod may be compared again with the basal part of the sagittal ring of *Cortina*, and this comparison becomes very important in those forms like *Plagiocarpa procortina* (Pl. 91, fig. 5). Here the four spines approach very nearly to those of *Cortina;* the two ventral spines (or pectoral feet) on the anterior pole of the middle rod are equal, but very different from the two dorsal spines, arising from the posterior pole; the lower odd spine of the latter corresponds to the "caudal foot," the upper spine to the "apical horn" of *Cortina* and of the Cyrtellaria. The vertical plane, determined by these two dorsal spines, is the sagittal plane, and two opposite curved branches which lie in this plane (an upper arising from the basal part of the apical spine and a lower arising from the anterior pole of the middle rod) may be regarded as ventral parts of an incomplete sagittal ring. This interesting form and some other similar Tetraplagida may be regarded either as beginning Stephoidea (*Cortina*, with incomplete sagittal ring) or as retrograde Stephoidea (*Cortina*, with partly reduced sagittal ring). In every case they seem to indicate the near relationship between the Stephoidea and Plectoidea.

Another argument for this close relationship may be found in the position of the central capsule in the interesting genus *Plagiocarpa* (Pl. 91, fig. 5). Its basal part (with the porochora) rests upon the common central rod, its ventral face upon the ventral prolongation of the latter, its dorsal face upon the apical horn; its axis lies in the sagittal plane. The three basal spines (the odd caudal and the paired pectoral feet) diverge from its basal pole downwards in the same manner as in the Cortinida, the Zygospyrida and the Monocyrtida.

Less important than those quadriradial Tetraplagida and Tetraplectida, are the sexradial Plectoidea, the Hexaplagida and Hexaplectida. These may be derived immediately from the triradial Plectoidea by prolongation of the three primary original spines (of *Plagiacantha*) over the common central point. Here also two

different kinds of central junction are found. In the simpler case all six radial spines arise from a common central point (*Hexaplagia* and *Hexaplecta*). In the other case the six radial spines arise from the two poles of a short horizontal common central rod, opposed in two groups, each of three spines (*Plagonium* and *Plectanium*, Pl. 91, figs. 6, 11). In this latter case the single corresponding spines of the two opposite groups are usually parallel, and exhibit therefore exactly the same characteristic "geminate-triradiate" form which is found in many Beloidea (*e.g.*, in the common *Sphærozoum punctatum* and the similar *Lampoxanthium punctatum*).

The fourth and last group of this suborder contains the multiradiate Plectoidea, the Polyplagida and Polyplectida. Here the number of radial spines, diverging from the common centre, exceeds six, and is commonly seven to nine, at other times ten to twelve or more (*Polyplagia* and *Polyplecta*, Pl. 91, fig. 12). When these two genera are better known from further accurate observations, they may probably be divided into several different genera (as already proposed in my Prodromus, 1881), since not only the number, but also the central junction and the arrangement of the numerous radial spines in the few observed species seems to be very different. In some seven-radiate species (*e.g.*, *Polyplecta heptacantha*) four larger spines seem to be true "cortinar spines," the three smaller secondary productions of the former. In the nine-radiate species the nine spines seem to be sometimes basal branches of three primary spines, at other times six secondary intercalated between the three primary (like *Enneaphormis*, Pl. 57, fig. 9). In those multiradial Plectoidea, in which the number of spines amounts to ten or twelve or more, the laws of disposition are not yet recognised.

Comparing these different productions of the skeleton in the numerous Plectoidea, we find expressed two remarkable and very different affinities. On the one hand many Plectoidea exhibit exactly the same peculiar forms, which are only found besides in the Beloidea (as many species of *Triplagia*, *Plagiacantha*, *Tetraplagia*, *Plagonidium*, *Hexaplagia*, and *Plagonium*). On the other hand many Plectoidea bear the same characteristic composition of the skeleton (or the "cortinar structure") which is found in the Cortinida among the Stephoidea, and in numerous Spyroidea and Cyrtoidea, which all agree in the possession of three divergent basal feet and a vertical apical horn. A most important argument for the close affinity of all these "cortinar NASSELLARIA" seems to be given by the fact that the sagittal ring, which in *Cortina* is combined with the quadriradial structure, exhibits in the Cyrtellaria the most different stages of development; in one group it is complete, in the second incomplete, and in the third it has completely disappeared.

The form of the radial spines composing the skeleton is usually three-sided prismatic, gradually tapering from the thicker central base towards the distal apex; sometimes they are slender pyramidal. More rarely the spines are cylindrical or slender conical. In the majority of species the spines are straight, in the minority more or

less curved. In very few species only are they quite simple, without branches. They are nearly always more or less branched, in many larger species very richly ramified. The modes of ramification are rather variable. In the majority of Plectoidea the spines are rather regularly verticillate, bearing an increasing number of verticils, each of which is composed of three divergent branches. These arise from the three edges of the spine, and all the branches of one edge are usually parallel, either perpendicular to the spine, or directed at an acute angle towards its apex. When the verticils are numerous (five to ten or more), their size commonly tapers gradually towards the apex. Pinnate spines occur more rarely than verticillate ones; in this case the two paired lateral edges only of the prismatic spine bear opposite or alternate branches, whilst the odd middle edge bears no ramules. In some species the spines are singly or doubly forked. In many species (mainly those with cylindrical spines) the ramification of the spines is more or less irregular.

Whilst in all Plagonida the branches of the spines remain perfectly free, in all Plectanida, again, the meeting ends of the branches become united and grow together, and by this concrescence a loose network arises, like wickerwork, which partly encloses the central capsule and the central parts of the spines, on which it rests. The meshes of this loose wickerwork are large, either quite irregular, of very different size and form, or more or less regular, with a certain form and arrangement of the meshes, effected by the peculiar kind of ramification. Commonly the siliceous threads of the arachnoidal wickerwork are very thin, often extremely delicate, representing "pseudopodia metamorphosed into silex." Sometimes the wickerwork is spongy. Its surface is constantly rough and bristly, with free ends of the spine-branches, never covered with a regular lattice-plate, as in the Cyrtellaria (Spyroidea, Botryodea, and Cyrtoidea).

The entire form of the central wickerwork is in the minority of Plectanida quite irregular and indefinite; in the majority, however, a certain more or less regular entire form is recognisable, effected by a certain, more or less regular origin and mode of the connection of the meeting branches. So in some species of *Triplecta* (Pl. 91, fig. 7) the network represents a triangular plate, of *Plectophora* and *Plectaniscus* a three-sided pyramid, of *Tetraplecta* (Pl. 91, fig. 3) a tetrahedron, and in many other species a polyhedron of more or less regular form. Some species of Plectanida become very similar to certain species of Stephoidea, Spyroidea, and Cyrtoidea; so *Plectaniscus* and *Periplecta* approach to *Cortina* and *Cortiniscus*, *Pteroscenium* and *Clathrocorys*, &c. (compare Pls. 92, 93, 53, 64, &c.). They may represent a true phylogenetic connection between both groups. But in these cases also the distinction is determined by the fact that the true Plectoidea never possess a complete sagittal ring (like the Stephoidea) nor a regular lattice-shell (like the Spyroidea, Botryodea, and Cyrtoidea).

*The Central Capsule* of the Plectoidea constantly exhibits the peculiar characters of the MONOPYLEA or NASSELLARIA. It is commonly ovate, more rarely ellipsoidal or even spherical, sometimes conical or lentelliptical. The lower or basal pole of its vertical main axis constantly exhibits the characteristic "porochora" (or the area porosa) of the MONOPYLEA, and upon this rests the peculiar "podoconus" (or the pseudopodial-cone) of this legion. On this porochora the central capsule is in immediate connection with the central point of the skeleton, or the horizontal common central rod, from which the radial spines arise. The endoplasm, or the protoplasm of the central capsule (besides the podoconus), contains commonly one large alveole or several small vacuoles, and often pigment-granules. The nucleus is large, spherical or ovate, and exhibits the same character as in all the other MONOPYLEA; it encloses usually a single nucleolus.

The position of the central capsule and its topographical relation to the skeleton offers in the different Plectoidea some important and as yet unsolved problems, which can be answered only by fresh and accurate observations on living specimens. In *Triplagia* and *Triplecta*, where the triangular skeleton lies in a horizontal plane, the vertical main axis of the central capsule is perpendicular to the central point of that supporting triangle. In *Plagiacantha* and *Plectophora*, where the three radial spines correspond to the edges of a flat pyramid, the capsule is enclosed in the pyramidal space of the latter, its basal pole touching the apex; therefore in the normal position of the body the three divergent rays are directed upwards. In *Tetraplagia* and *Tetraplecta* probably the same position is retained, and therefore the fourth free spine, here developed, is probably directed vertically downwards. In *Plagoniscus* and *Plectaniscus*, however, and, moreover, in the closely allied *Plagiocarpa* and the corresponding *Periplecta* (Pl. 91, figs. 5, 10) the position of the central capsule, relative to the skeleton, seems to be inverse, and to agree with that of the Stephoidea (*Cortina*, *Cortiniscus*, &c.) and the Cyrtoidea (*Pteroscenium*, *Clathrocorys*, &c.); the three divergent spines are here directed downwards (as basal feet), whilst the opposite fourth spine is vertically directed upwards (as an apical horn); the capsule rests here upon the tripod, which lies below it, and is inclined with its dorsal face to the apical spine. In the majority of the other Plectoidea the position of the central capsule and its relation to the skeleton are not yet sufficiently observed, and require further accurate researches. Its position seems to be very different in the several genera. The capsule is never perforated by parts of the skeleton; this latter is constantly extra-capsular.

The physiological value of the skeleton, with regard to the central capsule, is different in the Plagonida and Plectanida; in the former it supports, in the latter it encloses the capsule like a shell. In the Nassellida, where no skeleton is developed, the central capsule is quite free and naked, enveloped only by the calymma.

The calymma or the extracapsular jelly-veil in all Plectoidea is voluminous, and encloses not only the central capsule completely, but also the skeleton wholly or partially. Its form is of the greatest value for the development and configuration of the skeleton. Sometimes the calymma is alveolate and foamy, as in *Nassella* and the common *Thalassicolla*. In several other Plectoidea the calymma seems to include numerous small vacuoles, sometimes also pigment-granules. Xanthellæ are commonly scattered in it in great numbers. The pseudopodia, arising in a large bunch from the porochora of the capsule, and running along the branches of the radial spines, seem to be always numerous, richly branched, and with a strong tendency to form anastomoses. The peculiar form of their network is often exactly preserved in the conformation of the skeleton, produced by them. The peculiarities of this network require further accurate observations, as does the whole organisation of the Plectoidea.

### *Synopsis of the Families of* Plectoidea.

I. Skeleton (originally tripodal) composed of radial spines united in a common centre and supporting the central capsule, without wicker-work, . . 1. PLAGONIDA.

II. Skeleton (originally tripodal) wattled, with irregular wicker-work, composed of the united branches of radial spines and enveloping the central capsule, . . 2. PLECTANIDA.

## Family XLVI. PLAGONIDA, Haeckel.

*Plagonida*, Haeckel, 1881, Prodromus, p. 423.
*Plagiacanthida* (*sensu strictiori*), Richard Hertwig, 1879, Organismus d. Radiol., p. 72.

*Definition.*—Plectoidea with a spiny skeleton, composed of radial spines, which arise from a common central point or central rod, and support the free central capsule.

The family Plagonida comprises those NASSELLARIA in which the skeleton is only composed of united radial spines, arising from a common centre, without any connection of meeting branches of the spines; the rudimentary skeleton exhibits therefore neither a loose wickerwork (as in the closely allied Plectanida), nor a ring (as in the Stephoidea), nor a complete lattice-shell (as in the Cyrtellaria, the Spyroidea, Botryodea, and Cyrtoidea). The central capsule, which possesses all the characters of the MONOPYLEA, is therefore free, not enclosed, and only on one side supported or partly protected by the radial spines or their branches.

Two species only of Plagonida have been hitherto known. The first form described is the *Plagiacantha arachnoides*, discovered thirty years ago (1855) by Claparède on the western shore of Norway. Another species of the same genus, from the Mediterranean, was very accurately described by Richard Hertwig in 1879 in his Organismus der

Radiolarien (*Plagiacantha abietina*). Upon these two species the latter founded his family Plagiacanthida, a term which was afterwards employed by Bütschli and others, for the whole group of Plectoidea. Many new forms are contained in the collection of the Challenger, so that we may describe here nine genera and thirty-four species.

The family Plagonida may be divided into four different subfamilies, according to the numbers of the radial spines which compose the skeleton: Triplagida with three, Tetraplagida with four, Hexaplagida with six, and Polyplagida with numerous (seven to nine or more) radial spines. These are united commonly in one common central point, upon which rests the basal pole of the central capsule, with the porochora. More rarely (in the genera *Plagonidium*, *Plagiocarpa*, and *Plagonium*) the spines arise in two opposite groups (each with two or three spines) from the two poles of a common central rod; in this case the basal pole of the central capsule with the porochora rests upon the horizontal common rod, which corresponds probably to the basal part of the sagittal ring of the Stephoidea and Cyrtellaria.

The different forms which the skeleton of the Plagonida assumes in the different genera of this family, and the important relations which these exhibit on the one hand to the spicula of the Beloidea, and on the other hand to the shell of some Stephoidea (*Cortina*, *Cortiniscus*, &c.) and Cyrtoidea (*Pteroscenium*, *Clathrocorys*, &c.), have been already pointed out in the preceding description of the suborder Plectoidea. There it is also demonstrated, that all these different forms may be derived from the simplest triradial forms, *Triplagia* and *Plagiacantha* (compare above, pp. 900–904).

Whilst the genera of the Plagonida are characterised by the number of the radial spines and the peculiar mode of junction in a common central point or at the two poles of a common central rod, the different species of this family may be defined by the peculiar form of the spines and their branches. These morphological characters have also been already described above. We repeat here only that the radial spines in the majority of species are three-sided prismatic and verticillate, each verticil commonly with three branches. The distal ends of these branches remain constantly free, and are never united, as is always the case in the following family.

*The Central Capsule* of the Plagonida exhibits the general characters of all Monopylea (compare above, p. 890). It is commonly ovate or ellipsoidal, with vertical main axis; on the lower pole of the latter is the porochora (or the "area porosa," from which all pseudopodia radiate). This is in immediate connection with the central point or central rod of the skeleton, in which its radial spines are united. The topographical relation of the supporting skeleton to the central capsule seems to exhibit in the different genera of the Plagonida remarkable differences, as already demonstrated above (p. 905).

## *Synopsis of the Genera of Plagonida.*

| | | | |
|---|---|---|---|
| I. Subfamily Triplagida. Three radial spines. | Three spines lying in one horizontal plane, | | 384. *Triplagia.* |
| | Three spines corresponding to the edges of a flat pyramid, | | 385. *Plagiacantha.* |
| II. Subfamily Tetraplagida. Four radial spines. | Four spines arising from one common central point. | All four spines equal, | 386. *Tetraplagia.* |
| | | One apical spine opposed to three basal spines, | 387. *Plagoniscus.* |
| | Four spines arising in two pairs from the poles of a common central rod. | All four spines equal, | 388. *Plagonidium.* |
| | | One apical spine opposed to three basal spines, | 389. *Plagiocarpa.* |
| III. Subfamily Hexaplagida. Six radial spines. | Six spines arising from one common central point, | | 390. *Hexaplagia.* |
| | Six spines arising in two opposite groups from the poles of a common central rod, | | 391. *Plagonium.* |
| IV. Subfamily Polyplagida. Numerous radial spines. | Numerous (seven to nine or more) radial spines arising from a common centre (either a central point or a branched rod), | | 392. *Polyplagia.* |

### Subfamily 1. TRIPLAGIDA, Haeckel, 1881, Prodromus, p. 423.

*Definition.*—Plagonida with three radial spines.

### Genus 384. *Triplagia*,[1] Haeckel, 1881, Prodromus, p. 423.

*Definition.*—Plagonida with three radial spines, arising from one common central point and lying in one horizontal plane.

The genus *Triplagia* and the following closely allied *Plagiacantha* may be regarded as the simplest and most primitive forms of the Plectoidea, perhaps as the common ancestral stock of this suborder. The skeleton is composed of three simple or branched radial spines, arising from one common central point. These three spines in *Triplagia* lie in one and the same plane, whilst in *Plagiacantha* they lie in different planes. Therefore the former exhibits the simplest type of the triradial structure, common to the majority of NASSELLARIA.

[1] *Triplagia*=Triangular or three-radial; τριπλάγιος.

1. *Triplagia primordialis*, n. sp. (Pl. 91, fig. 2).

Spines straight, of equal size and similar form, equidistant, three-sided prismatic, each with two pairs of opposite lateral branches, which are correspondingly parallel to the two other spines; the proximal branches twice as long as the distal branches.

*Dimensions.*—Length of each spine 0·2, of the basal branches 0·07.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Triplagia triradialis*, n. sp.

Spines straight, of equal size and similar form, equidistant, three-sided prismatic, regularly pinnate, with six pairs of opposite pinnulæ, tapering gradually towards the distal ends; the basal pinnulæ are again branched, with straight ramules.

*Dimensions.*—Length of each spine 0·27, of the basal branches 0·08.

*Habitat.*—North Pacific, Station 256, surface.

3. *Triplagia horizontalis*, n. sp.

Spines curved, cylindrical, irregularly branched, with three primary and nine to twelve secondary branches, which are also slightly curved. The angles between the bases of the three spines are equal, but the size and form of the branches different.

*Dimensions.*—Length of the three spines 0·15 to 0·25, of the basal branches 0·05 to 0·08.

*Habitat.*—West Tropical Pacific, Station 225, depth 4475 fathoms.

## Genus 385. *Plagiacantha*,[1] Claparède, 1856, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, November 13.

*Definition.*—Plagonida with three radial spines, arising from one common central point and corresponding to the edges of a three-sided pyramid.

The genus *Plagiacantha* agrees with the preceding *Triplagia* in the simple structure of the triradial skeleton, composed of three diverging radial spines, which are united in a common centre at the oral pole of the central capsule. But whilst the three radial rods of *Triplagia* lie in one horizontal plane, here they lie in different planes and correspond to the three edges of a flat pyramid. *Plagiacantha arachnoides*, described in 1856 by Claparède, was the earliest known form of all Plectoidea.

[1] *Plagiacantha* = Having spines on the sides; πλάγιος, ἄκανθα.

1. *Plagiacantha arachnoides*, Claparède.

*Plagiacantha arachnoides*, Claparède, 1856, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, November 13.

*Plagiacantha arachnoides*, Claparède, 1858, Études sur les Infusoires et les Rhizopodes, p. 462 (pl. xxii. fig. 8).

*Acanthometra arachnoides*, Claparède, 1855, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 675.

Spines straight, cylindrical, divided into three divergent straight branches of equal size; each branch two to three times as long as the simple thicker basal part.

*Dimensions.*—Length of the spines 0·12 to 0·2, of the branches 0·08 to 0·14.

*Habitat.*—North Atlantic, coast of Norway, Claparède, surface.

2. *Plagiacantha furcata*, n. sp.

Spines straight, cylindrical, divided into two divergent straight branches of equal size, of about the same length as the simple basal part. The spines and their branches are smooth.

*Dimensions.*—Length of the spines 0·24, of their fork-branches 0·12.

*Habitat.*—North Pacific, Station 254, surface.

3. *Plagiacantha dodecantha*, n. sp.

Spines straight, three-sided prismatic, in the middle with one verticil composed of three divergent straight branches of equal size, of about the same length as the simple basal part. The edges of the spines and their branches are thorny.

*Dimensions.*—Length of the spines 0·24, of the branches 0·1.

*Habitat.*—Central Pacific, Station 274, surface.

4. *Plagiacantha abietina*, Richard Hertwig.

*Plagiacantha abietina*, Richard Hertwig, 1879, Organismus d. Radiol., p. 72, Taf. vii. figs. 6–6*b*.

Spines straight, three-sided prismatic, with three verticils of three divergent straight lateral branches, decreasing in size towards the distal end; the branches of the first verticil about twice as long as those of the second, and four times as long as those of the third verticil. All nine branches of each spine simple, straight, three-sided pyramidal.

*Dimensions.*—Length of the spines 0·2 to 0·3, of the basal branches 0·06 to 0·08.

*Habitat.*—Mediterranean, Messina (R. Hertwig), surface.

5. *Plagiacantha verticillata*, n. sp.

Spines curved, three-sided prismatic, with six to nine verticils of three divergent branches, decreasing in size towards the distal end; the branches of the first verticil about twice as long as those of the fourth verticil. All branches simple, slightly curved, bristle-shaped.

*Dimensions.*—Length of the spines 0·27, of the basal branches 0·12.

*Habitat.*—South Pacific, Station 296, surface.

6. *Plagiacantha elatine*, n. sp.

Spines straight, three-sided prismatic, with prominent wing-like edges and ten to twelve verticils of three divergent branches, decreasing in size towards the distal end; the branches of the three or four basal verticils are again ramified and much larger than the simple branches of the distal verticils.

*Dimensions.*—Length of the spines 0·36, of the basal branches 0·14.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Subfamily 2. TETRAPLAGIDA, Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plagonida with four radial spines.

### Genus 386. *Tetraplagia*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plagonida with four equal radial spines, arising from one common central point, and corresponding to the four axes of a tetrahedron.

The genus *Tetraplagia* is one of the most important Plectoidea, and possibly the common ancestral form of many NASSELLARIA (compare above, p. 901). The skeleton is composed of four radial rods, diverging from one common centre in different directions, and corresponding to the four axes, which extend from the central point of a tetrahedron to the central points of its four faces. The whole skeleton of *Tetraplagia* exhibits therefore the same form, which is observed in the single quadriradiate spicula of some Beloidea (in some species of *Lampoxanthium*, *Sphærozoum*, &c.).

1. *Tetraplagia geometrica*, n. sp.

Spines straight, cylindrical, perfectly equal, corresponding in regular disposition exactly to the four geometrical axes of a regular tetrahedron; in the middle arise from each spine two opposite equal lateral branches of half the length of the spine.

*Dimensions.*—Length of the spines 0·12; of the branches 0·06.

*Habitat.*—Central Pacific, Station 266, surface.

2. *Tetraplagia phænaxonia*, n. sp. (Pl. 91, fig. 3).

Spines straight or slightly curved, three-sided prismatic, with irregular short branches arising from the three edges; the branches are thorny, tapering towards the apex.

*Dimensions.*—Length of the spines 0·15, of the basal branches 0·03.

*Habitat.*—Tropical Atlantic, Station 332, surface.

[1] *Tetraplagia* = Four-sided; τετραπλάγιος.

3. *Tetraplagia abietina*, Haeckel.

*Plagiacantha abietina*, var. *quadrispina*, Richard Hertwig, 1879, Organismus d. Radiol., p. 73.

Spines straight, three-sided prismatic, verticillate, with six to eight verticils of three simple straight branches; the branches of each edge are parallel, tapering towards the distal end. R. Hertwig regards this species only as a four-spined variety of his three-spined *Plagiacantha abietina*; but a specimen, observed by me in Corfu, exhibited all the characters of *Tetraplagia*.

*Dimensions.*—Length of the spines 0·2, of the basal branches 0·07.

*Habitat.*—Mediterranean (Messina, Corfu), surface.

## Genus 387. *Plagoniscus*,[1] n. gen.

*Definition.*—Plagonida with four unequal radial spines, arising from one common central point; one vertical or apical spine opposed to three divergent or basal spines.

The genus *Plagoniscus* agrees with the preceding *Tetraplagia* (its probable ancestral form) in the possession of four radial spines, diverging from one common central point. But whilst in this latter all four spines are equal, corresponding exactly to the four axes of a tetrahedron, here in *Plagiocarpa* an important difference exists between one vertical or apical spine and three other divergent basal spines; these latter corresponding probably to the three "feet," the former to the single "apical horn" of the majority of NASSELLARIA. Perhaps we find here one of the oldest and simplest types of their "triradial or cortinar structure" (compare above, p. 902).

1. *Plagoniscus tripodiscus*, n. sp. (Pl. 91, fig. 4).

Spines three-sided prismatic, thorny. Apical spine nearly straight, verticillate, with four to five verticils of three thorny branches, tapering towards the apex. Three basal spines somewhat shorter, curved, with three thorny edges.

*Dimensions.*—Length of the apical spine 0·2, of the basal spines 0·15.

*Habitat.*—Central Pacific, Station 263, surface.

2. *Plagoniscus euscenium*, n. sp.

Spines three-sided prismatic, thorny, with dentate edges, and three to six verticils of three short branches. Apical spine straight, with six verticils, nearly twice as long as the three curved basal spines, each of which bears three verticils; the basal verticils larger and ramified. Resembles somewhat *Euscenium eucolpium*, Pl. 53, fig. 12, but has no latticed shell.

*Dimensions.*—Length of the apical spine 0·3, of the basal spines 0·16.

*Habitat.*—North Pacific, Station 247, surface.

[1] *Plagoniscus*=Side—windlass; πλάγος, ὀνίσκος.

3. *Plagoniscus cortinaris*, n. sp.

Spines three-sided prismatic, straight, verticillate. Apical spine with twelve verticils, one and a half times as long as the three basal spines, each of which bears eight verticils of three branches. The branches are also prismatic, straight, on each edge parallel, tapering towards the apex, in the three basal spines forked, in the apical spine more branched. Similar to the cortinar skeleton of *Clathrocorys* (Pl. **64**, figs. 8–10).

*Dimensions.*—Length of the apical spine 0·24, of the basal spines 0·16.

*Habitat.*—South Atlantic, Station 338, surface.

4. *Plagoniscus nassellaris*, n. sp.

Spines cylindrical, curved, irregularly branched. Apical spine half as long as, and less branched than the three basal spines, which are sigmoidal, nearly horizontally expanded in the proximal half, descending in the distal half.

*Dimensions.*—Length of the apical spine 0·1, of the three basal spines 0·18.

*Habitat.*—West Tropical Pacific, Station 224, surface.

Genus 388. *Plagonidium*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plagonida with four equal radial spines, arising in pairs from the two poles of a common central rod.

The genus *Plagonidium* and the following *Plagiocarpa* possess four radial spines, like the two preceding genera. But whilst the four rods in these latter arise from a common centre, here they arise in two pairs from the two poles of a common middle rod; they have therefore exactly the same form which we find in the single spicula of some Beloidea (*e.g.*, *Thalassoxanthium furcatum*, *Sphærozoum furcatum*, &c.). Probably the middle rod is horizontal and serves as supporting base for the central capsule, whilst two opposite spines are directed upwards, two other downwards.

1. *Plagonidium bigeminum*, n. sp.

Spines straight, three-sided prismatic, four to six times as long as the common central rod, pinnate, with four to five pairs of opposite pinnulæ, the distal of which are simple, the proximal again branched.

*Dimensions.*—Length of the spines 0·16, of the middle rod 0·032.

*Habitat.*—Indian Ocean, Sunda Strait (Rabbe), surface.

[1] *Plagonidium* = Small side-article; πλαγωνίδιον.

2. *Plagonidium quadrigeminum*, n. sp.

Spines cylindrical, curved, eight to ten times as long as the common central rod, in the distal half forked; the fork-branches curved, somewhat longer than the basal part.

*Dimensions.*—Length of the spines 0·18, of the middle rod 0·02.

*Habitat.*—Antarctic Ocean, Kerguelen Island, Station 159, surface.

## Genus 389. *Plagiocarpa*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plagonida with four unequal radial spines, arising in pairs from the two poles of a common central rod; one ascending apical spine opposed to three descending basal spines.

The genus *Plagiocarpa* agrees with the preceding *Plagonidium* in the possession of a common horizontal middle rod, the two poles of which bear two pairs of divergent spines; but whilst in the preceding all four spines are equal, here they are differentiated in the same manner as in *Plagoniscus*, which differs only in the absence of the middle rod. The two observed and closely allied species of this genus are of peculiar interest, since they belong possibly to the common ancestral forms of the NASSELLARIA; the basal middle rod corresponds perhaps to the basal part of a sagittal ring, the apical spine to its dorsal part, the three other spines to the basal feet (compare above, p. 902).

1. *Plagiocarpa procortina*, n. sp. (Pl. 91, fig. 5).

Spines cylindrical, curved, thorny, three to four times as long as the common middle rod. Apical spine and the meeting caudal spine (or the posterior basal spine) somewhat larger and with more numerous thorns than the two paired pectoral (or anterior) spines. From the common base of the latter arises an anterior prolongation of the horizontal middle rod, which in the sagittal plane is curved upwards and corresponds to the sternal foot of many Cyrtellaria. An ascending branch of this spine is opposed to a descending branch of the apical spine, both together forming an incomplete sagittal ring.

*Dimensions.*—Length of the two larger spines 0·15, of the two smaller 0·12.

*Habitat.*—Mediterranean (Portofino near Genoa), surface.

2. *Plagiocarpa procyrtella*, n. sp.

Spines of form and arrangement similar to those of the preceding species, but longer and more branched, six to eight times as long as the shorter common middle rod. The two characteristic

[1] *Plagiocarpa* = Having its fruit (the central capsule) on the side; πλαγιόκαρπος.

opposed branches (the ascending branch of the basal rod and the descending branch of the apical spine), which in the preceding species nearly compose a sagittal ring, are here absent.

*Dimensions.*—Length of the two larger 0·27, of the two smaller 0·21.

*Habitat.*—North Atlantic, Iceland (Steenstrup), surface.

## Subfamily 3. HEXAPLAGIDA, Haeckel.

*Definition.*—Plagonida with six radial spines.

### Genus 390. *Hexaplagia*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plagonida with six radial spines, arising from one common central point.

The genus *Hexaplagia* differs from the preceding genera of Plagonida in the possession of six radial spines, diverging from one common central point. Commonly, these six spines seem to lie opposite in pairs in three different meridian planes, and in this case *Hexaplagia* may be regarded as a *Plagiacantha*, the three radial spines of which are prolonged over the basal pole of the central capsule. But in other species the six spines seem to lie in different planes. Further observations are required.

#### 1. *Hexaplagia arctica*, n. sp.

Spines opposite in pairs in three diameters, crossed in the common centre, straight, three-sided prismatic, with dentate edges. The three pairs are equal, but the upper spine of each pair only half as long as the lower spine.

*Dimensions.*—Length of the upper spine 0·13, of the lower 0·27.

*Habitat.*—Arctic Ocean (Greenland), in the stomach of a Medusa (Olrik).

#### 2. *Hexaplagia antarctica*, n. sp.

Spines opposite in pairs in three diameters, crossed in the common centre, slightly curved, three-sided prismatic, with verticillate branches; the three pairs are equal, but the lower spine of each pair bears three to four verticils, each of three branches, and is two to three times as long as the upper spine, which bears two verticils only.

*Dimensions.*—Length of the upper spine 0·12, of the lower 0·3.

*Habitat.*—Antarctic Ocean, Station 157, depth 1950 fathoms.

[1] *Hexaplagia* = Six-sided; ἑξάπλάγιος.

3. *Hexaplagia collaris*, n. sp.

Spines in opposite pairs in three diameters, crossed in the common centre, straight, cylindrical, pinnate, with three to four pairs of opposite lateral branches or regular pinnulæ. All six spines are equidistant, of equal size and similar form, and lie with their branches nearly in one horizontal plane. Therefore they are similar to the six radial rods in the collar septum of many Spyroidea and Cyrtoidea (*e.g.*, *Calpophœna*, Pl. **53**, fig. 18).

*Dimensions.*—Length of all six spines 0·18, of their basal pinnulæ 0·04.

*Habitat.*—East of New Zealand, Station 169, surface.

4. *Hexaplagia australis*, n. sp.

Spines unequal, at unequal intervals, not opposite in pairs, cylindrical, irregularly branched and curved. In this species a definite arrangement of the six different spines could not be detected.

*Dimensions.*—Length of the spines 0·2 to 0·3, of their largest branches 0·1.

*Habitat.*—South of Australia, Station 160, surface.

Genus 391. *Plagonium*,[1] Haeckel, 1881, Prodromus, p. 423.

*Definition.*—Plagonida with six radial spines, arising in two opposite divergent groups from the two poles of a common central rod.

The genus *Plagonium* differs from the preceding closely allied *Hexaplagia* in the remarkable peculiarity, that the six radial spines do not arise from one common central point, but from the two poles of a common horizontal middle rod; three divergent spines on each pole. The skeleton of *Plagonium* exhibits therefore the same remarkable form which is found in the isolated spicula of numerous Beloidea (*e.g.*, *Lampoxanthium punctatum*, *Sphærozoum punctatum*), and bears the same relation to *Hexaplagia* that *Plagonidium* does to *Tetraplagia*.

1. *Plagonium sphærozoum*, n. sp. (Pl. **91**, fig. 6).

Spines straight and stout, three-sided prismatic, about twice as long as the common middle rod, irregularly branched or nearly verticillate, with short thorny branches. Similar to the single spicula of some species of *Sphærozoum* and *Lampoxanthium*.

*Dimensions.*—Length of the spines 0·12, of the middle rod 0·06.

*Habitat.*—Equatorial Atlantic, Station 347, surface.

[1] *Plagonium* = Side-article; πλάγιος, ἄνιον.

2. *Plagonium lampoxanthium*, n. sp.

Spines irregularly curved, slender, cylindrical, six to eight times as long as the common middle rod, in the proximal half smooth, in the distal half covered with short thorns. (Similar to an isolated spiculum of *Lampoxanthium punctatum* or of *Sphærozoum variabile*, Pl. 4, fig. 5.)

*Dimensions.*—Length of the spines 0·18, of the middle rod 0·03.

*Habitat.*—North Pacific, Station 240, surface.

3. *Plagonium arborescens*, n. sp.

Spines irregularly curved and branched, slender, cylindrical, thorny, twelve to sixteen times as long as the middle rod; the branches are large, arborescent, their ramules again ramified and very thorny.

*Dimensions.*—Length of the spines 0·2 to 0·25, of the middle rod 0·02.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

4. *Plagonium trigeminum*, n. sp.

Spines straight, slender, cylindrical, four to six times as long as the middle rod, in the basal half smooth, in the distal half arborescent, with three to four irregular verticils of ramified branches. (Similar to a single spiculum of *Sphærozoum verticillatum*, Pl. 4, fig. 7.)

*Dimensions.*—Length of the spines 0·15 to 0·2, of the middle rod 0·05.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

5. *Plagonium distriactis*, n. sp.

Spines straight and stout, three-sided prismatic, smooth, ten to twelve times as long as the middle rod; each on the distal end cleft into three divergent straight branches, which are again trichotomous.

*Dimensions.*—Length of the spines 0·15 to 0·18, of the middle rod 0·015.

*Habitat.*—South Pacific, Station 288, surface.

## Subfamily 4. POLYPLAGIDA, Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plagonida with numerous (seven to nine or more) radial spines.

### Genus 392. *Polyplagia*,[1] n. gen.

*Definition.*—Plagonida with numerous (seven to nine or more) radial spines, arising from a common centre and lying in different planes.

[1] *Polyplagia*=Manifold; πολυπλάγιος.

The genus *Polyplagia* alone represents the small subfamily of Polyplagida, distinguished from the other Plagonida by the multiplication of the radial spines, the number of which amounts to seven to nine or more. This increased number is commonly the result of an intercalation of new spines between the three or four primary spines; it is sometimes also effected by stronger development of branches of the latter, which become independent. The following five species of this genus are very different, require further investigation, and perhaps represent different genera:—

1. *Polyplagia septenaria*, n. sp.

Seven radial spines, straight, three-sided prismatic, verticillate, of different sizes; four larger spines correspond to the four axes of a tetrahedron (running from the centre to the four corners), each with five to six verticils of three simple slender branches; one of these four main spines seems to be the apical, the three others the basal spines of *Plagiocarpa;* in the three meridian planes between the latter and the former lie the three smaller spines, diverging upwards, each with two to three verticils. (Similar to *Polyplecta heptacantha*, Pl. **91**, fig. 12, but without connection between the branches.)

*Dimensions.*—Length of the four major spines 0·26, of the three minor 0·11.

*Habitat.*—Central Pacific, Station 274, surface.

2. *Polyplagia octonaria*, n. sp.

Eight radial spines, straight, three-sided prismatic, of equal size, arising in two opposite groups from the two poles of a short common middle rod (as in *Sphærozoum arborescens*, Pl. **4**, fig. 8, and in other Beloidea). The four spines of each group are divergent, six to eight times as long as the middle rod, each spine armed with three to four verticils of thorny branches.

*Dimensions.*—Length of the spines 0·15, of the middle rod 0·022.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

3. *Polyplagia novenaria*, n. sp.

Nine radial spines of equal size, straight, cylindrical, lying nearly in a horizontal plane, or forming a very flat pyramid. Near the common central point every three spines arise from a short common rod, so that the centre of the skeleton is triradial. Each spine bears towards the apex two divergent straight lateral branches. This species may have been derived from *Plagiacantha arachnoides* by shortening and reduction of the basal parts of the three original branched primary spines.

*Dimensions.*—Length of the nine spines 0·24, of the three basal rods 0·02.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray, surface.

4. *Polyplagia duodenaria*, n. sp.

Twelve radial spines of equal size, arising from a common central point, and diverging in different directions. The twelve spines are very large, opposite in six pairs, cylindrical, longitudinally

striped (the expression of concentric lamellæ), and with spinulate surface, covered with innumerable small thorns. The basal quarter of each spine is straight and simple, the second quarter twice forked, and these four fork-branches are again in the outer half of the spine richly forked or ramified, with diverging, slightly curved thin branches; each of the twelve spines with about sixty to eighty terminal branches, the ends of which seem to fall into a spherical face. The position of this remarkable species in this family is doubtful.

*Dimensions.*—Length of the spines 0·12 to 0·16, of the simple basal part 0·04.

*Habitat.*—South Pacific (off Juan Fernandez), Station 299, surface.

5. *Polyplagia viminaria*, n. sp.

Numerous (sixteen to twenty or more) radial spines of about equal size, arising from a common central point and diverging in different directions, richly and more or less irregularly branched. The ends of the numerous small branches seem to fall into a spherical face. The large spines of this species have the same form and structure as in the preceding, nearly allied species, but are more numerous and more irregularly branched and disposed.

*Dimensions.*—Length of the spines 0·2 to 0·25, of the simple basal part 0·05.

*Habitat.*—North Pacific, Station 241, surface.

## Family XLVII. PLECTANIDA, Haeckel.

*Plectanida*, Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectoidea with a wattled skeleton, composed of the meeting and united branches of radial spines, which arise from a common central point or central rod, and protect the partly enclosed central capsule.

The family Plectanida comprises those NASSELLARIA in which the skeleton is composed of radial spines, arising from a common centre, and of a loose wickerwork, produced by concrescence of the meeting branches of those spines. This rudimentary wattled skeleton is either quite irregular or only slightly regular, but it never assumes the form of a complete lattice-shell, as in the Cyrtellaria (the Spyroidea, Botryodea, and Cyrtoidea), nor does it exhibit a ring (as in the Stephoidea). The central capsule is partly or wholly protected, and often entirely enclosed by the wattled skeleton.

Three species only of Plectanida have been hitherto known. The first described form is *Plectophora arachnoides*, which its discoverer Claparède observed in a living state in 1855 on the western coast of Norway, and considered as a mere variety of his *Plagiacantha arachnoides*. Two other species were afterwards observed in the Mediterranean, *Polyplecta dumetum*, 1856, by Johannes Müller (united by him with *Acanthodesmia*) and *Polyplecta polybrocha* by myself in 1864. Many new forms are found in the

collection of the Challenger, so that we may here distinguish eight genera and twenty-seven species.

The family Plectanida may be divided into four different subfamilies, according to the number of the radial spines which compose the skeleton. These four subfamilies, as also the genera contained in them, correspond exactly to the four subfamilies of Plagonida, from which they have originated: Triplectida with three, Tetraplectida with four, Hexaplectida with six, and Polyplectida with numerous (seven to nine or more) radial spines. These spines are usually united (as in the corresponding ancestral Plagonida) in one common central point, upon which rests the basal pole of the central capsule, with the porochora. More rarely (in the genera *Periplecta* and *Plectanium*) the spines arise in two opposite groups (each of two or three spines) from the two poles of a common horizontal central rod, which supports the overlying porochora of the central capsule.

The different genera of Plectonida, which are enumerated in the following synopsis, correspond so exactly to the different genera of Plagonida described above, that probably each of the former has arisen from a corresponding genus of the latter. The only difference between the two is, that in all Plagonida the branches and ramules of the radial spines end freely, without growing together, whilst in all Plectanida the meeting ends of the neighbouring spines grow together and so produce a loose and irregular wickerwork. Therefore the latter constantly possess meshes, which are missing in the former. As soon as any form of Plagonida begins to produce meshes by concrescence of meeting branches of the spines, it passes over into a corresponding form of Plectanida. The loose wickerwork or wattlework so produced is sometimes very irregular, at other times more or less regular; but it never assumes the regular form of a complete lattice-shell, as in the Cyrtellaria (Spyroidea, Botryodea, and Cyrtoidea). The general differences which this wickerwork exhibits in the different genera of Plectanida have been already described above (compare pp. 900–904).

*The Central Capsule* of the Plectanida agrees perfectly with that of the ancestral Plagonida, as well in general form and structure as in the peculiar topographical relation to the radial spines (compare above, p. 905). A slight difference between the two families is effected by the higher development of the skeleton in the Plectanida. Since the branches of the radial spines in this family become united and form a loose wickerwork, the central capsule becomes more or less enclosed by the latter, and more perfectly protected, than in the Plagonida, where the branches remain free. In this respect the Plectanida approach more nearly to the Cyrtoidea with which they are connected by such transitional forms as *Plectaniscus* and *Periplecta* on the one hand, *Cladoscenium* and *Pteroscenium* on the other.

*Synopsis of the Genera of Plectanida.*

| | | | |
|---|---|---|---|
| I. Subfamily Triplectida. Three radial spines. | Three spines lying in one horizontal plane, | | 393. *Triplecta.* |
| | Three spines corresponding to the edges of a flat pyramid, | | 394. *Plectophora.* |
| II. Subfamily Tetraplectida. Four radial spines. | Four spines arising from one common central point. | All four spines equal, | 395. *Tetraplecta.* |
| | | One apical spine opposed to three basal spines, | 396. *Plectaniscus.* |
| | Four spines arising in two pairs from the poles of a common central rod; one apical spine different from three basal spines, | | 397. *Periplecta.* |
| III. Subfamily Hexaplectida. Six radial spines. | Six spines arising from one common central point, | | 398. *Hexaplecta.* |
| | Six spines arising in two opposite groups from the poles of a common central rod, | | 399. *Plectanium.* |
| IV. Subfamily Polyplectida. Numerous radial spines. | Numerous (seven to nine or more) radial spines arising from a common centre (either a central point or a branched rod), | | 400. *Polyplecta.* |

## Subfamily 1. TRIPLECTIDA, Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectanida with three radial spines.

## Genus 393. *Triplecta*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectanida with three radial spines, arising from one common central point and lying in one horizontal plane.

The genus *Triplecta* is the simplest and most primitive of the Plectanida, and may therefore be regarded as the prototype of this family. The skeleton represents a triangular lattice-plate with three radial beams. On the central union of the latter rests the oral pole of the central capsule. Since the axis of the latter is vertical, the lattice-plate must be horizontal, serving for the expansion of the pseudopodia. *Triplecta* has arisen from *Triplagia* by union of the branches of its three radial spines. In the simplest case only three large meshes are formed, corresponding probably to the three cortinar meshes in the collar septum of many Cyrtellaria.

### 1. *Triplecta triangulum*, n. sp.

Spines straight, equal, smooth, cylindrical, each in the basal half with one pair of divergent straight lateral branches. The opposed branches of every two neighbouring spines are united by a

[1] *Triplecta* = Hunting net with three beams; τρίς, πλεκτή.

thin convex bow. In this way arises a very simple, equilateral triangular skeleton, with three equal large meshes.

*Dimensions.*—Length of the spines 0·14, sides of the triangle 0·16.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

2. *Triplecta triactis*, n. sp. (Pl. 91, fig. 7).

Spines straight, equal, three-sided prismatic, pinnate, each with three to four pairs of opposite slender pinnulæ or lateral branches; the pinnulæ of each spine are correspondingly parallel to the main rods of the other two spines. All pinnulæ branched and connected by a few slender bows, marking the sides of a regular triangle.

*Dimensions.*—Length of the spines 0·15, sides of the triangle 0·17.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Genus 394. *Plectophora*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectanida with three radial spines, arising from one common central point and corresponding to the edges of a three-sided pyramid.

The genus *Plectophora* has been derived from *Plagiacantha* by union of the meeting neighbouring branches of the three radial spines, and exhibits therefore to it the same relation that *Triplecta* bears to *Triplagia*. The loose framework so produced corresponds to the three sides of a flat pyramid and supports the central capsule.

1. *Plectophora triomma*, n. sp.

Spines equal, straight, three-sided prismatic, thorny, connected by three convex bows, the meeting branches of lateral spines arising in one pair from the middle part of each spine. Therefore the skeleton exhibits three large ovate meshes only.

*Dimensions.*—Length of the spines 0·12, of the meshes 0·08.

*Habitat.*—North Pacific, Station 238, surface.

2. *Plectophora arachnoides*, Haeckel.

*Plagiacantha arachnoides*, var., Claparède, 1858, Études sur les Infusoires et les Rhizopodes, p. 462, Taf. xxii. fig. 9.

Spines straight, cylindrical, trifid, with one pair of lateral branches. The nine diverging, straight, and smooth branches are connected in the distal part by slender concave bows, so that the whole skeleton exhibits nine wide meshes, three larger pentagonal and six smaller triangular.

*Dimensions.*—Length of the spines 0·14, of their branches 0·07.

*Habitat.*—North Atlantic, west coast of Norway (Claparède), surface.

[1] *Plectophora* = Bearing a hunting net; πλεκτή, φέρος.

3. *Plectophora novena*, n. sp.

Spines slightly curved, three-sided prismatic, thorny, with two pairs of lateral branches. The six smaller distal branches end freely, whilst the six larger basal branches are connected by slender convex bows. There are therefore nine wide meshes, as in the preceding closely allied species.

*Dimensions.*—Length of the spines 0·18, of the basal branches 0·08.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream) (John Murray), surface.

4. *Plectophora pyramidalis*, n. sp.

Spines straight, three-sided prismatic, with three to four verticils of short lateral branches. The branches of the basal verticils are again ramified, and form by connecting bows a delicate loose framework, covering the three sides of a flat pyramid, the three edges of which are the three radial spines.

*Dimensions.*—Length of the spines 0·2, base of the pyramid 0·16.

*Habitat.*—Central Pacific, Station 267, surface.

## Subfamily 2. TETRAPLECTIDA, Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectanida with four radial spines.

### Genus 395. *Tetraplecta*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectanida with four equal radial spines, arising from one common central point and corresponding to the four axes of a tetrahedron.

The genus *Tetraplecta* has been derived from *Tetraplagia* by union of the neighbouring branches of the four radial spines, diverging from a common point in different directions. In some forms of this genus the four rods seem to correspond exactly to the four axes, which are directed from the centre of a tetrahedron towards its four corners; whilst in other forms the four rods and the angles between them are perhaps not perfectly equal.

1. *Tetraplecta tetrahedra*, n. sp.

Spines straight, equal, three-sided prismatic, pinnate, each with three or four pairs of opposite straight slender pinnulæ or lateral branches; the pinnulæ of each side are correspondingly parallel.

[1] *Tetraplecta* = Hunting net with four beams; τέτρα, πλεκτή.

All pinnulæ connected by a few slender bridges, thus producing a delicate network with irregular rhomboidal meshes.

*Dimensions.*—Length of the spines 0·15, of the basal branches 0·05.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Tetraplecta quadricornis*, n. sp.

Spines in the basal half straight, in the distal half slightly curved and irregularly branched, with two to three pairs of unequal alternate lateral branches, the distal ends of which are connected by a few slender bows, marking the six edges of an irregular tetrahedron.

*Dimensions.*—Length of the spines 0·22, of the basal branches 0·14.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Tetraplecta pinigera*, n. sp. (Pl. 91, fig. 8).

Spines three-sided prismatic, straight, or in the basal half slightly curved, verticillate; each spine with six to eight three-branched regular verticils, tapering gradually towards the distal end. All branches of each spine lie parallel in three equidistant meridian planes, and are connected by delicate parallel threads, perpendicular to the branches. Therefore the skeleton consists of four pine-shaped trees and twelve delicate triangular wings with rectangular meshes.

*Dimensions.*—Length of the spines 0·25 to 0·3, of the basal branches 0·1 to 0·15.

*Habitat.*—Central Pacific, Station 271, surface.

## Genus 396. *Plectaniscus*,[1] nov. gen.

*Definition.*—Plectanida with four unequal radial spines, arising from one common central point; one vertical or apical spine opposed to three divergent or basal spines.

The genus *Plectaniscus* has probably been derived from *Plagoniscus* by reticular union of the neighbouring branches of the four radial spines, and exhibits therefore to it the same relation that *Tetraplecta* bears to *Tetraplagia*. Whilst in these two latter genera the four spines are equal, in the two former genera there is an important difference between a vertical spine (or apical horn) and three divergent (commonly larger) spines, corresponding to the three basal feet of the triradiate NASSELLARIA. Perhaps, therefore, *Plectaniscus* is one of the remotest ancestors of the latter; but differs in the absence of a complete lattice-shell.

[1] *Plectaniscus*=Shell of wickerwork; πλεκτανίσκος.

1. *Plectaniscus cortiniscus*, n. sp. (Pl. 91, fig. 9).

Spines straight, three-sided prismatic, with three to four verticils of short perpendicular branches; the branches of the distal verticils are simple and free, those of the proximal verticils again ramified and connected by an arachnoidal network of delicate threads. The vertical apical spine (or horn) is scarcely one-third or half as long as the three divergent basal spines (or feet), and the angle between it and the latter is smaller.

*Dimensions.*—Length of the apical spine 0·05 to 0·1, of the three basal spines 0·18 to 0·2.

*Habitat.*—North Pacific, Station 244, surface.

2. *Plectaniscus tripodiscus*, n. sp.

Spines curved, cylindrical, with a variable number of irregular branches, which in the distal half of the spines are free, in the basal half again ramified and connected by a loose spongy framework. The apical spine is shorter and simpler, nearly straight, less ramified.

*Dimensions.*—Length of the apical spine 0·1, of the three basal spines 0·15 to 0·18.

*Habitat.*—North Pacific, Station 238, surface.

3. *Plectaniscus archiscenium*, n. sp.

Spines slightly curved, three-sided prismatic, with two to three verticils of short curved branches. The vertical apical spine is about twice as long as the three basal spines, and connected with them by an irregular loose framework. The three basal spines are connected together only by a simple ring, so that between them remain three large collar holes, like those of the similar and closely allied *Archiscenium quadrispinum* (Pl. 53, fig. 11).

*Dimensions.*—Length of the apical spine 0·32, of the three basal spines 0·18.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

4. *Plectaniscus cladoscenium*, n. sp.

Spines curved, three-sided prismatic. The three basal spines pinnate, with four to five pairs of opposite curved pinnulæ; the distal pairs are simple and free, the basal pairs branched and connected by an irregular delicate framework, which together with the apical spine forms a spongy cap-shaped shell, similar to *Cladoscenium*. Apical spine about half as long, simple.

*Dimensions.*—Length of the apical spine 0·1, of the three basal spines 0·18.

*Habitat.*—Central Pacific, Station 274, surface.

5. *Plectaniscus clathrocorys*, n. sp.

Spines straight, three-sided prismatic, with seven or eight verticils of ramified branches, which in the basal half are connected by an irregular loose framework. In the distal half each of the three divergent basal spines (or feet) is connected with the longer apical spine (or horn) by a

fenestrated triangular lattice wing. Therefore the skeleton becomes very similar to *Clathrocorys* (Pl. **64**, figs. 8–10), but wants the regular central cephalis.

*Dimensions.*—Length of the apical spine 0·2, of the basal spines 0·14.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 397. *Periplecta*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition*—Plectanida with four unequal radial spines, arising in pairs from the two poles of a common central rod; one ascending apical spine opposed to three descending basal spines.

The genus *Periplecta* has probably been derived from *Plagiocarpa* (by concrescence of the meeting spine branches), and has the same important relation to a part of the triradial Stephoidea (*Cortina*, &c.) and Cyrtoidea (*Pteroscenium*, &c.). It differs from the latter only in the fact that the loose irregular framework connecting the bases of the four cortinar spines is not a regular lattice-shell.

1. *Periplecta cortina*, n. sp. (Pl. **91**, fig. 10).

Spines of very different size and shape, three-sided prismatic. The apical spine (or horn) is larger, nearly straight, and bears a verticil of three large divergent branches, which are again ramified. The three basal spines (or feet) are curved, pinnate, each with three to five pairs of opposite simple curved branches. A small common central rod separates the two united pectoral feet from the two other spines (the caudal foot and the apical horn). The three basal feet are connected by three convex bows composing a horizontal collar ring, and since the central rod is prolonged between the pectoral feet to the ring, a very remarkable collar septum is formed with four cortinar meshes. Above this septum an irregular spongy shell, including the central capsule, is formed by a delicate framework, interwoven between the apical horn and the three basal feet.

*Dimensions.*—Length of the apical spine 0·25 to 0·3, of the three basal spines 0·15 to 0·2.

*Habitat.*—Central Pacific, Station 271, surface.

2. *Periplecta pteroscenium*, n. sp.

Spines of very different size and shape, three-sided prismatic, verticillate. The apical spine (or horn) with ten to twelve verticils, is one and a half times as long as the three basal spines (or feet), which bear six to eight verticils only; each verticil with three branches which by communicating ramules form a loose irregular wickerwork. Similar to *Pteroscenium pinnatum*, Pl. **53**, figs. 14–16, but without a regular lattice-shell. A short basal central rod separates two equal (pectoral) spines from two unequal spines, the larger of the latter is the apical, the shorter the caudal spine.

*Dimensions.*—Length of the apical spine 0·26, of the three basal spines 0·17.

*Habitat.*—Central Pacific, Station 274, surface.

[1] *Periplecta* = Surrounded by a hunting net; *περί*, *πλεκτή*.

3. *Periplecta monocyrtis*, n. sp.

Spines of nearly equal size and shape, cylindrical, irregularly branched. The apical spine is straight, more branched and nearly twice as long as the three basal spines. All four spines in the basal third connected by a loose spongy framework, approaching the form of some Monocyrtida.

*Dimensions.*—Length of the apical spine 0·24, of the basal spines 0·13.

*Habitat.*—Central Pacific, Station 274, surface.

## Subfamily 3. HEXAPLECTIDA, Haeckel.

*Definition.*—Plectanida with six radial spines.

### Genus 398. *Hexaplecta*,[1] Haeckel, 1881, Prodromus, p. 425.

*Definition.*—Plectanida with six radial spines, arising from one common central point.

The genus *Hexaplecta* has probably been derived from *Hexaplagia* by concrescence of the meeting branches of the six spines, and therefore has to it the same relation that *Plectophora* bears to *Plagiacantha*. The two species here described represent perhaps two different genera, since in the first all six spines are equal, opposed in pairs, in the second different in pairs (three upper smaller and three lower larger).

1. *Hexaplecta triaxonia*, n. sp.

Spines equal, opposite in three crossed pairs, straight, three-sided prismatic, thorny, in the distal half with three leaf-shaped, dentate edges, in the basal half with three verticils of slender branches, which are connected by parallel threads, and so form an arachnoidal network with rectangular or rhomboidal meshes.

*Dimensions.*—Length of the spines 0·22, of their basal branches 0·06.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

2. *Hexaplecta tricladonia*, n. sp.

Spines unequal, three larger spines (in the lower half of the body) being opposite to three smaller spines (in the upper half). The latter are nearly horizontally expanded, each bearing three straight divergent branches. The larger are stronger, twice as long and armed with three verticils, each of three branches. All six spines are slender, three-sided prismatic. Their branches are very thin, thread-shaped, and form by their union a loose network with irregular polygonal meshes.

*Dimensions.*—Length of the larger spines 0·25, of the smaller 0·12.

*Habitat.*—South Pacific, Station 291, surface.

[1] *Hexaplecta* = Hunting net with six beams; ἕξ-α, πλεκτή.

Genus 399. *Plectanium*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectanida with six radial spines, arising in two opposite divergent groups from the two poles of a common central rod.

The genus *Plectanium* has been derived from *Plagonium* by concrescence of the meeting branches, and bears therefore to it the same relation that the preceding *Hexaplecta* exhibits to *Hexaplagia*. Whilst in these two latter genera the six spines arise from a common central point, they arise here in two divergent groups from the two poles of a horizontal common middle rod, similar to the spicula of many Beloidea.

1. *Plectanium trigeminum*, n. sp. (Pl. 91, fig. 11).

Spines straight and stout, six to eight times as long as the common middle rod, three-sided prismatic; in the distal half thickened, with three divergent terminal thorns; in the basal half with three to four verticils of thin lateral branches, which are again ramified, and by their united threads produce an irregular loose framework.

*Dimensions.*—Length of the spines 0·25, basal breadth 0·005, terminal breadth 0·02; length of the middle rod 0·03.

*Habitat.*—North Pacific, Station 244, surface.

2. *Plectanium ovodimare*, n. sp.

Spines straight and stout, three-sided prismatic, about four times as long as the common middle rod, gradually thinned towards the distal end; in the basal half with two to three verticils of forked branches, which are dichotomously ramified, and by their united threads form a loose ovate framework.

*Dimensions.*—Length of the spines 0·17, of the middle rod 0·04.

*Habitat.*—North Pacific, Station 236, surface.

3. *Plectanium sphærozoum*, n. sp.

Spines straight, cylindrical, ten to twelve times as long as the common middle rod, with six to eight verticils of thorny branches, tapering towards the distal end; the branches of the verticils are simple in the distal half, again ramified in the basal half, and here connected together by irregularly branched threads forming a loose framework. (Resembles one spiculum of *Sphærozoum verticillatum*, Pl. 4, fig. 7, but is more richly branched, with united ramules.)

*Dimensions.*—Length of the spines 0·2, of the middle rod 0·01.

*Habitat.*—Central Pacific, Station 266, surface.

[1] *Plectanium*=Small wickerwork or network; πλεκτάνη.

Subfamily 4. POLYPLECTIDA, Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Plectanida with numerous (seven to nine or more) radial spines.

Genus 400. *Polyplecta*,[1] Haeckel.

*Definition.*—Plectanida with numerous (seven to nine or more) radial spines, arising from a common centre and lying in different planes.

The genus *Polyplecta* comprises provisionally all Plectanida possessing seven or more radial spines, united in the centre of the framework. It may be derived from *Polyplagia* by meeting and concrescence of the free branches. But as in the latter genus, here also the few observed species are very different, perhaps of different origin, and may be afterwards better separated as representatives of diverse genera.

1. *Polyplecta heptacantha*, n. sp. (Pl. 91, fig. 12).

*Heptaplegma heptacantha*, Haeckel, 1882, MS.

Seven unequal spines divergent from one common central point, slender, slightly curved, three-sided prismatic. Four spines are much larger, twice to three times as long and as thick as the three smaller spines. One of the four larger spines is directed upwards (as "apical horn"), whilst the three others diverge downwards (as "basal feet"). Each of the four larger spines bears five to seven equidistant verticils of three divergent branches, the proximal of which are branched, the distal simple. The three smaller spines lie nearly horizontally, midway between the odd apical spine and the three basal spines, and in the same meridian planes with them; each bears one verticil of three divergent branches. All the branches are united by arachnoidal threads, composing a loose wickerwork with irregular, generally quadrangular meshes.

*Dimensions.*—Length of the four larger spines 0·27 to 0·33, of the four smaller 0·1 to 0·14.

*Habitat.*—Central Pacific, Station 271, surface.

2. *Polyplecta enneacantha*, n. sp.

*Enneaplegma enneacantha*, Haeckel, 1881, Prodromus, p. 425.

Nine equal and equidistant, straight, cylindrical radial spines, lying nearly in one plane, arise from an irregular spongy central framework; six of them seem to be secondary, intercalated between three equidistant primary spines, which are united in the centre. (This species resembles in the nine-radial structure the remarkable *Enneaphormis rotula*, Pl. 57, fig. 9, and may perhaps be derived from a similar species; but it has no regular latticed shell.)

*Dimensions.*—Length of the spines 0·22, diameter of the framework 0·17.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

[1] *Polyplecta* = Much entwined; πολύπλεκτος.

### 3. *Polyplecta decacantha*, n. sp.

*Pentaplegma decacantha*, Haeckel, Prodromus, p. 425.

Ten radial spines, curved, cylindrical, irregularly branched, diverge in different directions and seem to arise in pairs from an irregular central framework, in the centre of which five primary spines are united; the latter correspond probably to the five spines of *Pentaspyris*, &c. The density of the spongy central framework did not allow of an accurate investigation, and makes it doubtful whether this species is not a *Spongiomma*.

*Dimensions.*—Length of the spines 0·3 to 0·4, diameter of the framework 0·18.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

### 4. *Polyplecta polybrocha*, Haeckel.

? *Acanthodesmia polybrocha*, Haeckel, 1865, Zeitschr. f. wiss. Zool., Bd. xv. p. 368, Taf. xxvi. fig. 3.

*Plegmosphæra polybrocha*, Haeckel, 1881, Prodromus, p. 455.

Numerous (twenty to thirty or more) radial spines, thin, cylindrical, curved and irregularly branched, arising from an irregular central spongy framework, are connected by numerous slender arches. The specimen observed by me in 1880 in Portofino was a true *Polyplecta*, with three primary spines centrally united, between which numerous other spines were intercalated. The similar specimen, however, observed in 1864 in Villafranca, and figured, *loc. cit.*, was perhaps a *Plegmosphæra*.

*Dimensions.*—Length of the radial spines 0·05 to 0·1, diameter of the framework 0·16.

*Habitat.*—Mediterranean (Villafranca, Portofino), surface.

### 5. *Polyplecta dumetum*, Haeckel.

*Acanthodesmia dumetum*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 30, Taf. i. fig. 3.

Numerous (ten to twelve or more) radial spines, thin and straight, with a few straight lateral branches, diverge in different directions and are connected by a few slender curved arches. Some similar forms, but more developed, with numerous branches and curved rods, are found in the Pacific Radiolarian ooze, and represent probably different species.

*Dimensions.*—Length of the radial spines 0·05 to 0·08, of the branches 0·02 to 0·03.

*Habitat.*—Mediterranean, French shore (Cette and Saint Tropez), Johannes Müller, surface

## Suborder III. STEPHOIDEA, Haeckel.

*Stephoidea* vel *Stephida*, Haeckel, 1881, Prodromus, p. 444.
*Acanthodesmida* (*sensu ampliori*), Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 495.

*Definition.*—NASSELLARIA without complete lattice-shell, with a skeleton composed of one or more simple rings, which may be united by a loose framework and are separated by large openings or gates. One primary or sagittal ring, determining the sagittal or median plane of the bilateral body, encloses the monaxonian central capsule.

The suborder Stephoidea, hitherto known by a few species only of "Acanthodesmida," comprises a large number of interesting NASSELLARIA (now more than two hundred species), which possess peculiar interest for the morphology and phylogeny of this legion. The monaxonian central capsule of the Stephoidea is surrounded either by one simple ring or by a complex system of several loosely connected rings; these may be united by a loose framework of connected branches, but never produce a complete lattice-shell, as is constantly the case in the Spyroidea, Botryodea, and Cyrtoidea. Therefore there remain between the parts of the connected rings a few large openings which we call "gates," separating them from the numerous small "pores" of the complete lattice-shells. In the most simple case, if only one ring be formed, there is also present only one "gate," the aperture of this simple ring.

The first known species of Stephoidea were observed in the Mediterranean by Johannes Müller in 1856, and described and figured in his last treatise (1858) under the names *Lithocircus annularis* (*loc. cit.*, Taf. i. fig. 1) and *Acanthodesmia vinculata* (*loc. cit.*, Taf. i. figs. 4–7). In the following year I myself observed two other living species in the Mediterranean, and described them in my Monograph (1862, pp. 268, 270) as *Zygostephanus mülleri* (Taf. xii. fig. 2) and *Prismatium tripleurum* (Taf. iv. fig. 6). For these four longest known Stephoidea I founded the new family of Acanthodesmida (*loc. cit.*, p. 265), but united with them two other similar genera which I afterwards separated:—*Plagiacantha* (belonging to the Plectoidea) and *Dictyocha* (belonging to the PHÆODARIA).

When, in 1876, I received the rich material of the Challenger collection, I was astonished to find in it an enormous number of new, similar, and partly very interesting "Acanthodesmida," which were afterwards arranged in my Prodromus (1881, p. 444) in thirty-eight different genera and four "subfamilies," all united in one single large family, "Stephida or Monopylaria cricoidea." I retain here this natural group in the same sense, but give to it the rank of a "suborder," separating at the same time its four subfamilies as substantial "families." Since the names of the

latter, proposed in the Prodromus, were not quite suitable, I replace them here by the following more convenient names :—

1. Family Stephanida (=Monostephida, 1881, p. 447). Skeleton entirely formed by one simple ring (the primary vertical sagittal ring). The only "gate" is the simple aperture of the ring.
2. Family Semantida (=Dyostephida, 1881, p. 446). Skeleton composed of two rings, perpendicular to one another; the primary vertical sagittal ring bears at the base a horizontal basal ring; between the two rings two or more "basal gates remain."
3. Family Coronida (=Triostephida, 1881, p. 445). Skeleton composed of two crossed vertical or meridional rings, perpendicular to one another—the primary sagittal ring and the secondary frontal ring. Commonly the two vertical rings are united at the base by a horizontal basal ring, and between them remain two or more "basal gates."
4. Family Tympanida (=Parastephida, 1881, p. 446). Skeleton composed of two parallel horizontal rings, an upper mitral ring, and a lower basal ring, both connected by vertical or divergent columellæ, which are parts of vertical rings (primary sagittal, and secondary frontal ring).

The peculiar structure of the central capsule of the Stephoidea, and their character as true MONOPYLEA, were first recognised by Richard Hertwig, who in 1879, in his Organismus der Radiolarien, gave an excellent detailed description of it (*loc. cit.*, pp. 68–72, Taf. vii. figs. 4, 5). He also pointed out the near affinity of these "Acanthodesmida" with the Spyroidea or Zygocyrtida, uniting the latter with the former family.

A fuller explanation of this affinity, and of the great morphological and phylogenetic importance of the "Acanthodesmida," as ancestral forms of the Spyroidea and Cyrtoidea, was given in 1882 by Bütschli (Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 495–501). He described in detail some important fossil forms of Acanthodesmida as different species of "*Stephanolithis*," a name which Ehrenberg had employed for various ring-like fragments of Radiolarian shells, sponges, and other fossil bodies. The four fossil species which Bütschli described represent four different genera of Stephoidea, viz., *Semantis* (*spinescens*), *Semantrum* (*mülleri*), *Semantidium* (*haeckelii*), and *Tristephanium* (*hertwigii*). On the phylogenetic conclusions, derived from these accurate observations, compare above, p. 893, &c. The topographical signification of the parts, employed by Bütschli, is contrary to mine; he calls my dorsal side the "anterior," and my ventral side the "posterior."

The geometrical fundamental form of the body in nearly all Stephoidea (with few exceptions) is distinctly bilateral or "dipleuric," so that we can easily distinguish the

three different dimensive axes: the principal axis with different apical and basal poles, the sagittal axis with different dorsal and ventral poles, and the lateral axis with equivalent right and left poles. In only a few genera this bilateral symmetry is not expressed, and a simpler, more regular fundamental form appears. The latter may be either primary (in the monaxonian *Archicircus* and *Lithocircus*) or secondary, afterwards acquired (in the octahedral *Trissocircus* and *Trissocyclus*, the cubical *Lithocubus*, the prismatic *Eutympanium*, and some other forms).

The most important element of the skeleton, with which its formation begins, in all Stephoidea is the simple primary or sagittal ring, lying vertically in the sagittal or median plane of the body and surrounding the monaxonian central capsule. This sagittal ring is the only essential element of the skeleton in all Stephanida, and is completely preserved in all Semantida, also in the greater part of the Coronida and Tympanida. It is partially reduced in the small groups of the true Acanthodesmida (subfamily of Coronida) and the Dystympanida and Eutympanida (subfamilies of Tympanida). Here only the vertical parts of it are preserved (dorsal and ventral rod), whilst the horizontal parts are lost (mitral and basal rod).

The sagittal ring lies constantly in the vertical median plane of the body, and therefore divides the enclosed central capsule into a right and a left half. It is rarely regular or subregular, commonly dipleuric or distinctly bilateral, so that we may easily distinguish its dorsal and ventral, apical and basal parts. The most important of these four parts or "rods" is the "basal rod" or the inferior part, because here the ring is in closer connection with the central capsule and its "porous area"; here peculiar spines or branches are commonly developed, which even on the isolated ring immediately determine the basal pole. The opposite upper part, or the "mitral rod," is also often distinguished by peculiar appendages. The posterior part, or the "dorsal rod" (the anterior rod, *a*, in the description of Bütschli), is commonly more straight, often quite vertical. The opposite anterior part, or the "ventral rod" (the posterior rod, *b*, of Bütschli), is usually more convex, and often strongly curved or semicircular.

Whilst this dipleuric or bilateral (commonly obliquely ovate or nearly triangular) form of the sagittal ring is distinctly preserved in by far the greater number of Stephoidea, it is replaced in some few genera by a more regular, amphithect, diphragmatic, or biradial form. In this case we may often suppose a primary regularity to exist, the dorsal and ventral parts being not yet differentiated, as in *Archicircus* and *Lithocircus*, *Zygostephanus* and *Protympanium*, and perhaps also in some other forms. But in other cases the regularity is, on the contrary, secondary, being derived from original bilateral forms.

The rod of the sagittal ring is either cylindrical (with circular transverse section) or angular (commonly with triangular transverse section). In nearly all Stephoidea (with very few exceptions) branches or apophyses are developed from the ring, regularly disposed and often of very great morphological importance. Commonly these

apophyses are developed in pairs, growing symmetrically on both sides of the ring. The most important of these apophyses are:—(1) basal apophyses, arising from the basal pole of the ring; (2) mitral apophyses, arising from the apical pole; (3) dorsal apophyses, arising from the middle of the dorsal rod; and (4) ventral apophyses, arising from the middle of the ventral rod. The two former arise in the principal axis, the two latter in the sagittal axis of the body. Very frequently the latter pair is replaced by two pairs of transverse branches, one inferior (mandibular) and one superior (orbital). The apophyses of the ring are either simple or branched, often very large, richly ramified, and give origin to a number of further products.

Whilst in the Stephanida the primary sagittal ring alone represents the whole skeleton, it produces in all other Stephoidea one or more secondary rings. The most important of these is the horizontal basal ring, appearing first in the Semantida (Pl. 92). From the base of the sagittal ring there arise in the horizontal basal plane two pairs of lateral branches or "basal apophyses." The curved opposite branches of the corresponding pairs become united on each side of the primary ring (right and left), and so produce a second, horizontal ring, perpendicular to the former. This basal ring encloses two paired basal gates, which are enclosed on the medial side by the basal rod of the sagittal ring, and on the lateral side by two united apophyses (*Semantis*, Pl. 92, figs. 1, 2). These two primary basal gates are of the greatest morphological importance; we call them the "jugular gates or jugular pores" (in the description of Bütschli, the pores I, *loc. cit.*, p. 498). The dorsal pair of basal apophyses (on their posterior edge) are the coracal rods, *e* (rods *e* of Bütschli); the opposite ventral pair (on their anterior edge) are the clavicular or furcular rods, *f* (rods *e*1 of Bütschli); compare Pls. 92–95, and their explanation.

The skeleton of *Semantis*, the prototype of the Semantida, thus assumes the characteristic form of a signet-ring. The basal ring enclosing the two jugular pores corresponds to the seal-plate. It is commonly more or less horizontal; but often the apophyses descend obliquely (Pl. 92, figs. 1, 2, 13, &c.), more rarely laterally (Pl. 29, fig. 11). The further development of this typical form is essentially effected by the production of new basal pores in the horizontal seal-plate. In *Semantrum* (Pl. 92, figs. 3, 4, 5) we find already four basal gates. Behind the jugular gates is formed a second pair, the "cardinal gates" (pores II of Bütschli). These are enclosed on the anterior margin by the coracal rods (*e*), on the posterior margin by the scapular rods (*d*), a third pair of basal apophyses, arising behind the former from the sagittal ring and uniting with them (the rods *e*2 of Bütschli). Commonly the two posterior, or cardinal gates are much larger than the two anterior, jugular gates. This characteristic basal plate of *Semantrum*, with two pairs of basal pores, is of the greatest morphological importance, as it is inherited in by far the greater number of the Nassellaria, though not so generally as Bütschli supposes. The basal ring of *Semantrum* is either more circular

or elliptical, or more polygonal, and is connected with the basal rod of the sagittal ring by three pairs of radial apophyses, the anterior furcular, the middle coracal, and the posterior scapular rods.

A third important form of Semantida is *Semantidium* (Pl. 92, figs. 6, 7). Here we find three pairs of basal pores in the seal-plate; the third pair, newly formed, consists of the cervical gates (*e*), bounded in front by the scapular rods (*d*), behind by a fourth pair of basal apophyses, the cervical rods.

The basal apophyses of the sagittal ring are not only of great morphological importance, because they produce by their union three typical pairs of basal gates or "collar pores," but also because their prolongations often appear as typical basal feet. The distal prolongations of the coracal rods appear in *Semantiscus* (Pl. 92, figs. 16–18) as two pectoral feet, those of the scapular rods as two tergal feet, whilst the opposite prolongations of the basal rod of the sagittal ring appear as two "sagittal feet" (in front an anterior or sternal, and behind a posterior or caudal foot). In the typical *Cortiniscus* (Pl. 92, figs. 11–13) only three feet are developed; an odd caudal and two paired pectoral feet (compare above, p. 891). The typical basal ring of the Semantida, with its paired basal gates (*Semantis*), reappears in the majority of the Coronida, differing from the former in the development of a second vertical ring, which lies in the frontal plane (perpendicular to the sagittal ring), and which we therefore call the frontal ring. In only one small group of the Coronida the basal ring is absent, namely, in the Zygostephanida, and here the frontal ring appears in the simplest form, as a complete elliptical meridian ring, crossing the sagittal ring perpendicularly on the two poles of the main axis (*Zygostephanus*, Pl. 93, figs. 1–4). Four large lateral gates between the two rings remain open. This form may be derived directly from the Stephanida in the following way; from both poles of a simple sagittal ring there arise two opposite lateral apophyses, which in the frontal plane become curved one towards the other, and united in the poles of the transverse axis. The basal apophyses would be the coracal rods. But it is also possible that *Zygostephanus* was derived from *Semantis* by the loss of the furcular rods.

The three typical rings (or the "dimensive rings") of the Stephoidea appear in their most complete form in the subfamily Trissocyclida (Pl. 93, figs. 7, 13). Here all three rings are undivided and completely developed in the three dimensive planes, perpendicular one to another. Between them there remain eight large open gates; the four superior are the four "lateral gates" of *Zygostephanus*, the four inferior are the four basal gates of *Semantrum*. The four latter are originally much smaller than the four former; but in *Trissocircus* and *Trissocyclus* (Pl. 93, figs. 10–12) they reach the same size. Therefore all eight gates are here of equal form and similar size, and the basal ring, now a true equatorial ring, divides the two meridional rings into two equal halves.

In the Eucoronida, a third subfamily of Coronida, the sagittal and the basal rings

are complete, but the frontal ring is incomplete, its basal part being wanting (Pl. 82, figs. 4–6). Therefore we find here six large gates between the three rings; four upper lateral gates (between the two crossed vertical rings) and two lower basal gates (between the basal rod of the sagittal ring and the two halves of the basal ring). *Eucoronis*, the type of this subfamily, may be derived either directly from *Semantis* by development of a frontal ring, or from *Tristephanium* by loss of the basal part of the frontal ring.

A quite simple basal ring, with a single gate, distinguishes the fourth subfamily of Coronida, the Acanthodesmida (*sensu restricto*), the genera *Coronidium* (Pl. 82, figs. 1, 2, 7, 8) and *Acanthodesmia* (Pl. 93, fig. 5). The horizontal basal ring alone is here complete, whilst both vertical rings (the sagittal and frontal rings) are incomplete, their basal parts being wanting. Therefore there are here five gates, four lateral and one basal. These forms may be derived from *Eucoronis* by loss of the basal rod of the primary sagittal ring.

The Tympanida, the fourth family of Stephoidea, exhibit another type of ring structure. Here two parallel horizontal rings are constantly developed, one on the apical pole, the other on the basal pole of the sagittal ring. The latter is the same basal ring as in the Semantida and Coronida. The former is a "mitral ring," developed in the same manner, by union of two pairs of horizontal lateral branches, which arise on both sides from the apical rod (or mitral rod) of the sagittal ring. In the simplest case these two parallel horizontal rings are connected only by the sagittal ring, which is either complete (*Protympanium*, Pl. 93, fig. 14) or incomplete (*Parastephanus*, Pl. 93, fig. 21). But commonly also an incomplete frontal ring is present, so that the two horizontal rings are connected by four vertical or subvertical rods; two of these "columellæ" are the dorsal and ventral rods of the sagittal ring, the two others are the lateral rods of the frontal ring. Between the former and the latter are sometimes developed two, four, or more accessory columellæ (probably halves of accessory incomplete diagonal meridian rings). In this way arise the characteristic "drum-forms" of many Tympanida, in which the two parallel horizontal rings correspond to the upper and lower rings of a drum, whilst the connecting vertical columellæ correspond to its parallel lateral rods (Pl. 83, figs. 1, 2, &c.).

Originally the two horizontal rings of these "drum-shells" are both bisected by the complete sagittal ring, each provided with two lateral gates (Protympanida). But in the Eutympanida both rings exhibit one simple gate only, the apical and the basal rod of the sagittal ring being lost. In the Paratympanida both rings are closed by a secondary lattice-plate, whilst in the Dystympanida the upper (mitral) ring alone is closed by such a plate, the lower (basal) ring is open. In some Eutympanida the shell assumes the strange form of a regular geometrical cube, the twelve edges of which are represented by thin rods of silex (*Lithocubus*)—its four upper edges represent the mitral ring, the four lower the basal ring; two opposite of the four vertical cube-

edges are the lateral halves of the frontal ring, the two other alternate ones are the remaining halves of the reduced sagittal ring (dorsal and ventral rod) (Pl. 82, fig. 12).

In many Tympanida and Coronida a loose irregular lattice or framework is developed, which partly closes the large open gates. But this never reaches the completeness of a true lattice-shell, such as we find in the Spyroidea, Botryodea, and Cyrtoidea. In by far the greater number of Stephoidea the corners, and partly also the rods, of the shell are armed with numerous irregular spines, often forked or richly branched. Among these spines the descending "basal apophyses" possess a peculiar importance, since by their regular number and disposition they correspond to the radial rods of the Plectoidea, and to the typical "feet" of the Spyroidea and Cyrtoidea. The most important of them are the three cortinar feet (one caudal and two pectoral) of *Cortina*, *Cortiniscus*, &c. (compare above, p. 891).

*The Central Capsule* exhibits in the Stephoidea the same characteristic structure as in all other MONOPYLEA, first exactly pointed out by Richard Hertwig in 1879 (Organismus der Radiol., p. 71, Taf. vii. figs. 4, 5). Its form is commonly ovate or ellipsoidal, sometimes also lentelliptical or nearly spherical. It exhibits constantly on the basal pole the porochora or porous area, and in the basal half the podoconus or pseudopodial cone. From the surrounding sagittal ring it is separated by a thick jelly-like calymma, which commonly exhibits numerous zooxanthellæ. The numerous pseudopodia are commonly branched, with rather rare anastomoses. The membrane of the central capsule is thick.

*Synopsis of the Families of* Stephoidea.

| | |
|---|---|
| I. Skeleton composed of the simple vertical sagittal ring only, without secondary rings, | 1. STEPHANIDA. |
| II. Skeleton composed of two crossed rings, a vertical sagittal and a horizontal basal ring, | 2. SEMANTIDA. |
| III. Skeleton composed of two crossed vertical meridional rings (a primary sagittal and a secondary frontal ring), commonly also with a horizontal basal ring, | 3. CORONIDA. |
| IV. Skeleton composed of two parallel horizontal rings (upper mitral and lower basal ring), both connected by a vertical sagittal ring (and often by a vertical frontal ring), | 4. TYMPANIDA. |

## Family XLVIII. STEPHANIDA, Haeckel (Pl. 81).

*Monostephida*, Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Stephoidea with a simple sagittal ring, without any lattice-work.

The family Stephanida is the most simple of all Stephoidea, and probably the common ancestral group of this suborder (compare above, p. 933). The skeleton

consists of a simple ring only, surrounding the central capsule, and armed commonly with simple thorns or with larger branched spines. The branches of these spines are constantly free, never joining together. Therefore the shell exhibits no trace of fenestration or lattice-work, no pores or gates, except the simple large gate of the ring itself. In all other Stephoidea we find secondary gates or lattice-work.

The first known form of this family is *Lithocircus annularis*, described by Johannes Müller in 1858 (Abhandl. d. k. Akad. d. Wiss. Berlin, p. 29, Taf. i. fig. 1). He observed already the central capsule ("Blase") surrounded by the circular ring of silex, and the calymma ("Strahlige Gallert") enveloping the whole body. The peculiar structure of the soft body, particularly the "area porosa" on the basal pole of the central capsule, and the pseudopodial cone within it, were first accurately described by Hertwig (in 1879). A great number of simple rings, similar to these, were found in the Challenger collection, and are here arranged in six genera and forty-eight species.

The simple ring of silex, which alone forms the skeleton of the Stephanida, corresponds to the primary or sagittal ring of the other Stephoidea, and lies therefore vertically in the median or sagittal plane of the body. We can therefore distinguish on it four different segments, rods or bows, two of which are more horizontal, two more vertical. The former are one upper bow or apical rod, and one lower bow or basal rod. The latter are one posterior bow or dorsal rod, and one anterior bow or ventral rod. Sometimes each of these four component bows is distinguished by a corner-spine, or by a pair of divergent branches.

In the two simplest (and probably oldest) genera of Stephanida, in *Archicircus* and *Lithocircus*, the dorsal and ventral rods of the ring are equal and cannot be distinguished; therefore the fundamental form is here amphithect, diphragmatic, or biradial (the poles of the sagittal axis being equal). In the four other genera the dorsal rod is more straight (often vertical) and more or less different from the ventral, convexly curved rod; therefore the fundamental form is here dipleuric or bilateral, as in the greater number of all NASSELLARIA (the poles of the sagittal axis being unequal). The general form of the ring in this latter case is commonly obliquely ovate or nearly triangular, the basal pole being more pointed, the apical pole more rounded (Pl. 81).

The rods or bows of the ring are either roundish or cylindrical (with circular or elliptical transverse section), or they are prismatic or angular (commonly with triangular transverse section). In the latter case one edge usually is prominent in the sagittal plane (on the convex outside of the ring), whilst two other edges diverge laterally on both sides of it. The inner or concave margin of the ring is commonly smooth.

The inner perimeter of the large gate, enclosed by the ring, is commonly rounded (elliptical or ovate), rarely angular. However, the outer perimeter of the ring is

nearly always polygonal, with prominent corners, and usually from these arise thorns or branched spines which are regularly disposed. Regarding this disposition we may distinguish three cases: A, the spines lie in the sagittal plane and form a single row, arising from the median edge; B, the spines lie on both sides of the latter and form two parallel rows, arising from the two lateral edges; C, the spines represent a combination of A and B, and are disposed in three rows, two paired rows arising from the two lateral edges, and an odd middle row between them, arising from the median edge. The spines are simple, without branches, in *Archicircus* and *Zygocircus;* more or less branched in *Lithocircus* and *Dendrocircus.* The branches are often richly ramified or arborescent, and exhibit great variety in size, special form, and direction (compare Pl. 81).

The number and disposition of the spines or groups of spines are usually constant, and may be employed in the further progress of our knowledge, to distinguish a number of genera and subgenera. Very commonly (perhaps in the majority of the Stephanida) we find six groups of spines, an apical group on the upper rod of the sagittal ring, a basal group on the lower rod (on the porochora of the central capsule), two ventral groups on the anterior rod, and two dorsal groups on the posterior rod. In other species we find four or eight groups instead of six, and sometimes a larger number.

The most important of these apophyses of the ring are the basal spines, arising from its basal pole, where the porochora of the central capsule rests upon it. They are often much larger and more branched than the other spines, and attain a peculiar morphological value in the small subfamily Cortinida. Here we find three or four regularly disposed "basal spines," which may be compared to the typical "basal feet" of the Cyrtellaria, appearing in the majority of Spyroidea and Cyrtoidea. *Cortina,* one of the most important NASSELLARIA, bears three typical divergent feet on the base of the simple ring, two paired anterior or "pectoral feet," and an odd posterior or "caudal foot." The latter appears as a direct basal prolongation of the dorsal rod of the ring, and is opposed to an upper prolongation of the same, which corresponds to the "apical horn" of the Cyrtellaria (Pl. 97, figs. 1–3). As already explained above, these three basal feet of *Cortina* possess the highest phylogenetic value, since they may also be compared with the three primary radial spines of the Plectoidea, and so connect the Cyrtellaria and the Plectellaria. *Stephanium* differs from *Cortina* in the possession of four basal feet, an odd anterior or "sternal foot" being added to the three typical feet of the latter (Pl. 92, figs. 20, 21). Some forms of Plectoidea (*Plagoniscus, Plectaniscus,* &c.) seem to be nearly related to these Cortinida, and may be easily transformed into them by development of a complete ring, embracing the central capsule. They seem to demonstrate the near affinity of all these triradiate NASSELLARIA (Pl. 91, figs. 4, 5, 9, 10).

*Synopsis of the Genera of Stephanida.*

| | | | |
|---|---|---|---|
| I. Subfamily Lithocircida. No typical basal feet on the base of the ring (no cortinar feet). | Ring diphragmatic or amphithect; dorsal and ventral bow equal. | Ring smooth or thorny, without branched spines. | 401. *Archicircus.* |
| | | Ring armed with branched spines, . . . | 402. *Lithocircus.* |
| | Ring dipleuric, bilateral; dorsal and ventral bow different. | Ring smooth or thorny, without branched spines, . | 403. *Zygocircus.* |
| | | Ring armed with branched spines. | 404. *Dendrocircus.* |
| II. Subfamily Cortinida. Three or four typical basal feet on the ring (cortinar feet). | Three basal feet (and an apical horn). | One caudal and two lateral feet, . . . | 405. *Cortina.* |
| | Four basal feet (and an apical horn). | Two sagittal and two lateral feet, . . . | 406. *Stephanium.* |

## Subfamily 1. Lithocircida, Haeckel.

*Definition.*—Stephanida without typical basal feet or cortinar feet.

### Genus 401. *Archicircus*,[1] n. gen.

*Definition.*—Stephanida with a simple amphithect or diphragmatic ring, smooth or thorny, without branched spines and basal feet.

The genus *Archicircus* is the most primitive and simplest form of all Stephoidea, and probably the common ancestral form, not only of this suborder, but of the greater number of all Nassellaria (compare above, p. 893). The skeleton consists only of a quite simple sagittal ring, in which commonly a slight difference of both poles of the main axis (basal and apical pole) is visible, but no difference between the dorsal and the ventral bow of the ring. In my Prodromus (1881, p. 447) the species of *Archicircus* were disposed partly in the subgenus *Monostephus*, partly in the genus *Lithocircus*.

#### Subgenus 1. *Monostephus*, Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Ring circular, elliptical, or ovate, without prominent corners.

1. *Archicircus princeps*, n. sp.

Gate circular. Ring circular, smooth, its transverse section also circular. The simplest form of all Stephoidea.

*Dimensions.*—Diameter of the gate 0·05 to 0·08; thickness of the ring 0·006 to 0·008.

*Habitat.*—Central Pacific, Stations 265 to 274, depth 2350 to 2925 fathoms.

[1] *Archicircus* = Primordial ring; ἀρχί, κίρκος.

2. *Archicircus monostephus*, n. sp. (Pl. 83, fig. 17).

Gate circular. Ring circular, with three elegantly denticulate edges (one outer median and two lateral edges). Transverse section of the ring triangular.

*Dimensions.*—Diameter of the gate 0·06 to 0·08; thickness of the ring 0·01 to 0·008.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

3. *Archicircus ellipsis*, n. sp.

Gate elliptical. Ring elliptical, on the inner margin smooth, on the outer margin with fifteen to twenty equal, short, simple, or slightly forked thorns. Transverse section ovate.

*Dimensions.*—Diameter of the gate 0·05 to 0·09; thickness of the ring 0·01 to 0·014.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms; also fossil in Barbados.

4. *Archicircus ovalis*, n. sp.

Gate ovate. Ring elliptical, smooth, with three prominent, slightly distorted edges, without thorns; in the transverse section triangular.

*Dimensions.*—Diameter of the gate 0·08 to 0·12; thickness of the ring 0·006 to 0·009.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

5. *Archicircus monopylus*, n. sp.

Gate ovate. Ring ovate, thorny, with three distorted edges, in the transverse section triangular; surface covered with numerous simple small thorns arising from the three edges.

*Dimensions.*—Diameter of the gate 0·1 to 0·15; thickness of the ring 0·01 to 0·012.

*Habitat.*—Indian Ocean (Madagascar), Rabbe, surface.

## Subgenus 2. *Archistephus*, Haeckel.

*Definition.*—Ring polygonal, with four to six or more prominent corners (and commonly with simple spines arising from the corners).

6. *Archicircus quadratus*, n. sp.

Gate square. Ring square, with three edges and four short simple pyramidal spines on the four corners, opposite in pairs in two perpendicular diameters. Transverse section triangular.

*Dimensions.*—Diameter of the gate 0·08; thickness of the ring 0·008.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### 7. *Archicircus rhombus*, n. sp. (Pl. 81, fig. 7).

Gate rhombic. Ring rhombic, with four prominent edges and four pairs of short, divergent, pyramidal spines on the four corners, arising from the lateral edges of the four rods, about as long as the radius of the gate.

*Dimensions.*—Diameter of the gate 0·04 to 0·08; thickness of the ring 0·007 to 0·01.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 8. *Archicircus duodenus*, n. sp.

Gate square or rhombic. Ring rhombic, with three prominent edges and twelve stout and straight pyramidal spines, about as long as the radius of the gate. In each of the four corners are three divergent spines, arising from the three edges of each two meeting rods.

*Dimensions.*—Diameter of the gate 0·08; thickness of the ring 0·012.

*Habitat.*—North Atlantic, surface (Rabbe).

### 9. *Archicircus primordialis*, n. sp. (Pl. 81, fig. 1).

Gate ovate. Ring hexagonal, with three prominent edges and six short pyramidal thorns at the six corners; the basal thorn is either simple or forked.

*Dimensions.*—Diameter of the gate 0·07; thickness of the ring 0·01 to 0·015.

*Habitat.*—Central Pacific, Stations 265 to 274, depth 2350 to 2925 fathoms.

### 10. *Archicircus hexacanthus*, n. sp. (Pl. 81, fig. 4).

Gate subregular, hexagonal. Ring hexagonal, with three sharp edges and six equal radial pyramidal spines, arising from the six corners and placed in the plane of the ring, about as long as the diameter of the gate.

*Dimensions.*—Diameter of the gate 0·05 to 0·07; thickness of the ring 0·01.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

### 11. *Archicircus hertwigii*, Haeckel.

*Lithocircus annularis*, R. Hertwig (*non* J. Müller), 1879, Organismus der Radiol., p. 69. Taf. vii. fig. 5.

Gate hexagonal, with prolonged main axis. Ring hexagonal, with two prominent edges and six pairs of equal, short, conical spines, arising from the two edges of the six rods at the six corners and divergent on each side of the plane of the ring. The basal spine-pair is doubled, therefore there are in all fourteen spines.

*Dimensions.*—Diameter of the gate 0·05 to 0·07; thickness of the ring 0·005 to 0·006.

*Habitat.*—Mediterranean (Messina), Hertwig, surface.

12. *Archicircus triglyphus*, n. sp.

Gate ovate. Ring hexagonal, with three prominent edges and twenty-two to twenty-four simple curved spines, arising from the six corners and about as long as the diameter of the gate. In the basal corner arise six to nine larger spines, protecting the basal pole of the central capsule. From each of the five other corners arise three spines, diverging from the three edges.

*Dimensions.*—Diameter of the gate 0·07 to 0·11; thickness of the ring 0·008 to 0·011.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

13. *Archicircus sexangularis*, n. sp. (Pl. 81, fig. 12).

Gate hexagonal or subcircular. Ring hexagonal, with two sharp prominent edges and six pairs of divergent spines, about as long as the radius of the gate, and arising from the two edges at the six corners. The two apical and the two basal spines are simple and conical, whilst the eight other spines, arising in pairs from the two dorsal and the two ventral corners, are slightly forked.

*Dimensions.*—Diameter of the gate 0·06 to 0·08; thickness of the ring 0·01 to 0·015.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

## Genus 402. *Lithocircus*,[1] J. Müller, 1856, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 484.

*Definition.*—Stephanida with a simple amphithect or diphragmatic ring, armed with branched spines, without typical basal feet.

The genus *Lithocircus* is the oldest known form of all Stephoidea, founded by J. Müller in 1856 for his *Lithocircus annularis*, the first species of this suborder described. We retain here this cosmopolitan form as the typical representative of the genus, which differs from the preceding *Archicircus*, its ancestral form, in the development of branched radial spines.

1. *Lithocircus annularis*, J. Müller.

*Lithocircus annularis*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 29, Taf. i. fig. 1.

Gate circular. Ring circular, with four forked or simply branched spines, opposite in pairs in two diameters, perpendicular one to the other. Spines with slender curved fork-branches, about as long as the diameter of the gate. The specimen figured by J. Müller bears a supernumerary fifth spine; numerous other specimens observed by me exhibited a regular cross of four spines.

*Dimensions.*—Diameter of the gate 0·1 to 0·15; length of the spines 0·01 to 0·18.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, surface.

[1] *Lithocircus*=Ring of silex; λίθος, κίρκος.

2. *Lithocircus quadricornis*, n. sp. (Pl. 81, fig. 9).

Gate square. Ring square, with three sharp denticulate edges, and four large bunches of richly branched spines on the four corners. In each corner arise three curved spines, about as long as the diameter of the ring; their numerous irregular branches are forked and curved like the antlers of deer.

*Dimensions.*—Diameter of the gate 0·07; length of the horns 0·06 to 0·09.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

3. *Lithocircus decimalis*, n. sp. (Pl. 81, fig. 15).

Gate elliptical. Ring pentagonal, with three prominent edges and five pairs of branched spines on the five corners. In each corner arise two or three curved spines, about as long as the radius of the gate, each with two to four forked branches.

*Dimensions.*—Diameter of the gate 0·08; length of the spines 0·03 to 0·05.

*Habitat.*—North Atlantic, Station 354, surface.

4. *Lithocircus hexablastus*, n. sp. (Pl. 81, fig. 17).

Gate elliptical. Ring hexagonal, with three prominent edges and six pairs of branched spines, arising from the six corners. Each of the twelve spines is short and stout, only half as long as the radius of the gate, and bears a bunch of ten to twenty short, densely aggregated, conical or horn-like curved branches.

*Dimensions.*—Diameter of the gate 0·1; length of the spines 0·02 to 0·03.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

5. *Lithocircus crambessa*, n. sp. (Pl. 81, fig. 6).

Gate elliptical or subcircular. Ring hexagonal, with three wing-shaped distorted edges and six groups of branched spines, arising from the six corners. In each corner arise three short and stout divergent spines, each bearing a bunch of numerous short roundish branches like a cauliflower, scarcely as long as the thickness of the ring.

*Dimensions.*—Diameter of the ring 0·1 to 0·12, length of the spines 0·01 to 0·02.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

6. *Lithocircus tarandus*, n. sp. (Pl. 92, fig. 19).

Gate circular. Ring hexagonal, with three sharp edges and six pairs of large branched spines, arising from the flat lateral edges on the six corners. Each of the twelve spines is horizontally expanded, longer than the diameter of the ring and dichtomously forked like the antlers of a rein-

deer. If the lateral ends of the branches of this species become united in the frontal plane, we get *Microcubus*, the four upper spines forming the mitral ring, the four middle the equatorial ring, and the four lower the basal ring.

*Dimensions.*—Diameter of the gate 0·08; length of the spines 0·09.

*Habitat.*—Central Pacific, Station 272, surface.

7. *Lithocircus furcatus*, n. sp.

Gate ovate. Ring ovate, with three sharp prominent edges. The two lateral edges are smooth, The median edge (in the sagittal plane) bears sixteen to twenty forked spines (commonly eight dorsal, eight ventral, and four basal). All the spines are of nearly equal size, slightly curved, and about half as long as the short sagittal axis of the ring.

*Dimensions.*—Diameter of the gate 0·08 to 0·12; length of the spines 0·03 to 0·04.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

8. *Lithocircus magnificus*, n. sp. (Pl. 81, fig. 16).

Gate ovate or nearly elliptical. Ring ovate, with three prominent edges, and numerous richly branched spines arising from the three edges. The specimen figured, which I observed living in the Mediterranean, exhibited eight bunches of larger spines, three dorsal, three ventral, one apical, and one basal bunch; the latter much larger than the seven others. Each bunch was composed of two to four larger and numerous smaller spines, their branches curved and forked. The ovate purple central capsule, with a distinct podoconus, filled more than the half of the gate.

*Dimensions.*—Diameter of the gate 0·1 to 0·13; length of the spines 0·05 to 0·15.

*Habitat.*—Mediterranean (Portofino, 1880), Atlantic (Canary Islands), Station 354, surface.

Genus 403. *Zygocircus*,[1] Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 496.

*Definition.*—Stephanida with a simple dipleuric or bilateral ring, smooth or thorny, without branched spines and basal feet.

The genus *Zygocircus* and the following *Dendrocircus* differ from the two preceding older genera in the bilaterally symmetrical or dipleuric form of the sagittal ring. Whilst in *Archicircus* and *Lithocircus* the two sagittal halves or bows of the ring, the dorsal and ventral bow, are equal (therefore the fundamental form amphithect or diphragmatic), here both bows become distinctly different; the dorsal bow is constantly more straight (often vertical), the ventral bow more convex (obliquely ascending). This dipleuric differentiation is most important, as it is transmitted to the greater number of NASSELLARIA by heredity.

[1] *Zygocircus* = Yoked or symmetrical ring; ζυγόν, κίρκος.

1. *Zygocircus sagittalis*, n. sp.

Gate ovate. Ring half ovate or nearly triangular, with three curved edges and three prominent corners, one apical and two basal protuberances. Dorsal rod vertical, twice as long as the horizontal basal rod. Ventral rod convexly curved.

*Dimensions.*—Diameter of the gate 0·05 to 0·07; height of the tubercles 0·01 to 0·015.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2900 fathoms.

2. *Zygocircus trigonus*, n. sp.

Gate triangular. Ring triangular, with three curved edges and three prominent corners, which are prolonged into nine divergent conical spines; three spines arising from the three edges of each corner. Dorsal rod vertical; ventral and basal rods curved and convergent.

*Dimensions.*—Diameter of the gate 0·11 to 0·13; length of the spines 0·01 to 0·015.

*Habitat.*—Indian Ocean, Sunda Archipelago (Rabbe), surface.

3. *Zygocircus tetragonus*, n. sp.

Gate ovate. Ring quadrangular, without edges, with four simple conical spines of different sizes; one smaller apical, one larger basal, and two equatorial spines of middle size (one dorsal and one ventral). Dorsal and ventral rod curved.

*Dimensions.*—Diameter of the gate 0·04 to 0·06; length of the spines 0·018 to 0·026.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

4. *Zygocircus rhombicus*, n. sp.

Gate rhombic. Ring rhombic, with three prominent edges, and eight short conical curved spines arising from the lateral edges at the four corners of the rhombus. The basal and ventral spine are larger than the apical and dorsal spine; the ventral rod is more curved (with smaller angle) than the shorter dorsal rod. The medial edge of the ring is smooth, without spines.

*Dimensions.*—Diameter of the gate 0·08; length of spines 0·02 to 0·04.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

5. *Zygocircus pentagonus*, n. sp. (Pl. 81, fig. 8).

Gate roundish pentagonal. Ring very thick (about as thick as the radius of the gate), irregularly pentagonal, with prominent sagittal edge. On both sides of the latter arise at the five corners five pairs of short simple irregularly curved spines. The four ventral spines are larger than the four dorsal, and the two basal spines larger than the eight former, forked. (In fig. 8 the basal spines are turned upwards.)

*Dimensions.*—Diameter of the gate 0·07; length of the spines 0·04 to 0·06.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

6. *Zygocircus hexagonus*, n. sp.

Gate irregularly hexagonal. Ring obliquely hexagonal, thick, without edges, with six short and stout conical spines on the six corners. The two spines of the curved ventral rod are longer than the two spines of the straight dorsal rod. The apical spine is smaller and the basal spine larger than the four others.

*Dimensions.*—Diameter of the gate 0·07 to 0·09; length of the spines 0·01 to 0·03.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

7. *Zygocircus triquetrus*, n. sp. (Pl. 81, fig. 3).

Gate obliquely ovate. Ring obliquely hexagonal, with three sharp edges and three short conical spines on each of the six corners. Therefore each hexagonal edge bears six short radial spines of equal size.

*Dimensions.*—Diameter of the gate 0·04 to 0·08; length of the spines 0·01 to 0·02.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, surface.

8. *Zygocircus dodecanthus*, n. sp.

Gate semicircular. Ring semicircular or irregularly hexagonal, without edges, with twelve short blunt spines, arising in pairs from the six corners; two apical, two basal, and between them two equatorial corners. Three pairs of spines remain on the straight dorsal rod, three on the curved ventral rod.

*Dimensions.*—Diameter of the gate 0·04 to 0·06; length of the spines 0·01 to 0·02.

*Habitat.*—Central Pacific, Stations 263 to 268; depth 2650 to 2900 fathoms.

9. *Zygocircus acacia*, n. sp. (Pl. 81, fig. 5).

Gate obliquely ovate. Ring semi-ovate, with straight dorsal and curved ventral rod, partly with distorted edges. Six bunches of numerous short and straight conical spines arise from the ring, one larger bunch (often trifid) from the apex, two smaller bunches from the dorsal, two from the ventral rod, and one very large bunch from the base. The six bunches are often more separated, smaller, and the spines shorter than in the figured specimen, which passes over into *Dendrocircus*.

*Dimensions.*—Diameter of the gate 0·12 to 0·16; length of the spines, 0·01 to 0·07.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

10. *Zygocircus polygonus*, n. sp. (Pl. 81, fig. 2).

Gate irregularly roundish or ovate. Ring irregularly polygonal or sometimes nearly circular, without edges, armed with a single series of ten to fifteen short pyramidal spines, which are irregularly

disposed in the sagittal plane. The ventral rod is strongly curved, often semicircular, the dorsal rod less curved or nearly straight.

*Dimensions.*—Diameter of the gate 0·05 to 0·07; length of the spines 0·004 to 0·02.

*Habitat.*—Cosmopolitan—Atlantic, Pacific; also fossil in Barbados.

11. *Zygocircus bütschlii*, n. sp.

*Zygocircus productus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 497.

Gate obliquely ovate. Ring irregularly roundish, semi-ovate or ovate, with interrupted and distorted edges, and with a large number (ten to twenty or more) of simple, irregularly formed and asymmetrically disposed spines; commonly some larger spines at the base.

*Dimensions.*—Diameter of the gate 0·05 to 0·09; length of the spines 0·005 to 0·02.

*Habitat.*—Fossil in Barbados.

12. *Zygocircus productus*, Bütschli.

*Zygocircus productus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 496.
*Lithocircus productus*, R. Hertwig, 1879, Organismus d. Radiol., p. 69, Taf. vii. fig. 4.

Gate obliquely ovate. Ring obliquely ovate, with three complete prominent edges and with numerous (ten to twenty or more) simple, short conical spines, arising in three series from the three edges; commonly some smaller spines at the base.

*Dimensions.*—Diameter of the gate 0·1 to 0·2; length of the spines 0·005 to 0·02.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, surface.

## Genus 404. *Dendrocircus*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Stephanida with a simple dipleuric or bilateral ring, armed with branched spines, without typical basal feet.

The genus *Dendrocircus* has the same dipleuric or bilaterally symmetrical form of the sagittal ring as its ancestral genus *Zygocircus*. It differs from the latter in the development of branched radial spines, and therefore bears to it the same relation as the amphithect *Lithocircus* does to the simpler *Archicircus*.

1. *Dendrocircus quadrangulus*, n. sp.

Gate irregularly quadrangular or nearly semicircular. Ring quadrangular, edgeless, with four unequal sides; ventral rod more curved and with longer sides than the dorsal rod. From the four edges arise four strong, irregularly branched spines, about as long as the diameter of the gate,

[1] *Dendrocircus*=Ring bearing trees; δένδρον, κίρκος.

with curved branches; the ventral and basal spines larger than the dorsal and apical spines. Similar to *Lithocircus quadricornis* (Pl. **81**, fig. 9), but less branched, and with a striking difference between the shorter dorsal and the longer ventral rod.

*Dimensions.*—Diameter of the gate 0·04 to 0·06; length of the spines 0·05 to 0·07.

*Habitat.*—North Pacific, Station 256, depth 2950 fathoms.

2. *Dendrocircus dodecarrhiza*, n. sp.

Gate obliquely ovate. Ring irregularly quadrangular, with three prominent edges. From the latter arise at the four corners twelve divergent, irregularly branched spines (three in each corner), about as long as the radius of the gate, with curved branches; the three basal spines larger than the nine others.

*Dimensions.*—Diameter of the gate 0·08 to 0·1; length of the spines 0·04 to 0·06.

*Habitat.*—Indian Ocean (Maldive Islands), surface (Haeckel).

3. *Dendrocircus dodecancistra*, n. sp. (Pl. **81**, fig. 11).

Gate obliquely ovate or nearly elliptical. Ring irregularly ovate, with three distorted edges and six pairs of branched spines. The two ventral pairs are much more distant than the two dorsal pairs, the ventral rod being longer and more curved than the dorsal rod. All twelve spines are of nearly equal size, are more or less curved, about as long as the diameter of the gate, and each bears six to twelve irregular short branches at the end.

*Dimensions.*—Diameter of the gate 0·07 to 0·08; length of the spines 0·05 to 0·08.

*Habitat.*—Tropical Atlantic, Station 342, depth 1445 fathoms.

4. *Dendrocircus arborescens*, n. sp. (Pl. **81**, fig. 10).

Gate irregularly roundish or nearly circular. Ring of the same form, with slight edges and six pairs of elegant arborescent spines (one apical, two dorsal, two ventral, and one basal pair); the three latter somewhat larger than the three former. Each tree is larger than the ring, in the basal half simple, in the distal half forked, each fork-branch with numerous dichotomous terminal branches.

*Dimensions.*—Diameter of the gate 0·06 to 0·08; length of the spines 0·12 to 0·15.

*Habitat.*—Central Pacific, Stations 266 to 274, surface.

5. *Dendrocircus elegans*, n. sp. (Pl. **81**, fig. 13).

Gate irregularly ovate. Ring thick, ovate, with three denticulate edges and six bunches of stout, branched and spinulate, curved spines. The four ventral spines are more distant than the four dorsal, the ventral rod being more curved than the dorsal. The latter bears above the two apical spines. The two basal spines are much larger, deeply forked; their four fork-branches may be compared to the four basal feet of *Stephanium*.

*Dimensions.*—Diameter of the ring 0·09 to 0·11; length of the spines 0·03 to 0·06.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

6. *Dendrocircus barbadensis*, n. sp.

Gate irregularly ovate or nearly semicircular. Ring of the same oblique form, thick, with interrupted and distorted edges, armed with eight to twelve larger irregularly formed and branched acute spines; between them numerous conical smaller spines. This common species is very polymorphous and variable.

*Dimensions.*—Diameter of the ring 0·05 to 0·08; length of the spines 0·005 to 0·02.

*Habitat.*—Fossil in Barbados.

7. *Dendrocircus stalactites*, n. sp. (Pl. 81, fig. 14).

Gate obliquely ovate. Ring irregularly ovate or roundish, very thick, without edges, armed with numerous (eight to twelve or more) short and stout branches, which are shorter than the diameter of the gate, irregularly disposed and branched, with very numerous clustered blunt ramules.

*Dimensions.*—Diameter of the gate 0·07 to 0·09; length of the spines 0·02 to 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Subfamily 2. CORTINIDA, Haeckel.

*Definition.*—Stephanida with typical basal feet (or cortinar feet).

### Genus 405. *Cortina*,[1] n. gen.

*Definition.*—Stephanida with a simple dipleuric or bilateral ring, bearing at the base three divergent feet (one odd caudal and two paired lateral feet).

The genus *Cortina* and the following *Stephanium* represent together the small but very important group of Cortinida, differing from the simple Lithocircida in the possession of three typical basal feet, which are transmitted to the majority of the NASSELLARIA by heredity, and produce their peculiar triradial structure. They appear therefore as a combination of the simple ring (*Zygocircus*) with three basal feet (*Plagonium*). One of these three divergent feet is the odd caudal foot, opposite to the apical horn; the two others are the paired lateral or pectoral feet. (On the probable origin and the typical signification of *Cortina* compare above, pp. 891–894.)

1. *Cortina tripus*, n. sp. (Pl. 83, fig. 9).

Ring ovate, smooth, or with a few short thorns. Apical horn oblique, curved, simple, smooth, about as long as the sagittal axis of the ring. Feet divergent, curved, simple, smooth, about as

[1] *Cortina* = Tripod.

long as the horn; the caudal foot shorter than the two pectoral feet. Very variable in form and size.

*Dimensions.*—Height of the ring 0·06 to 0·09, breadth 0·04 to 0·06; length of the feet 0·05 to 0·1.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, surface and in various depths.

2. *Cortina typus*, n. sp. (Pl. 97, fig. 1).

Ring kidney-shaped or nearly semicircular, with revolute vertical dorsal rod and strongly curved ventral rod; both rods with two pairs of spine-bunches. Apical horn nearly straight, thorny, longer than the ring, directed a little obliquely backwards. Feet slightly curved, of equal length, two to three times as long as the ring; each armed with few large bunches of curved spines, which are more developed in the caudal foot than in the two pectoral feet.

*Dimensions.*—Height of the ring 0·14, breadth 0·08; length of the feet 0·2 to 0·3.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

3. *Cortina conifera*, n. sp.

Ring subcircular, smooth. Apical horn and the three divergent feet of equal size and similar form, cylindrical, straight, about as long as the ring, at the distal end thickened, with a dimply cone (similar to *Tripospyris conifera* and *Tripospyris cucolpa*, Pl. 84, figs. 4, 7).

*Dimensions.*—Height of the ring 0·08, breadth 0·06; length of the feet 0·09.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

4. *Cortina furcata*, n. sp.

Ring elliptical, with three forked horizontal spines (one on the dorsal and two on the ventral rod). Apical horn and the three divergent feet of equal size, somewhat longer than the ring, slightly curved, in the distal half forked.

*Dimensions.*—Height of the ring 0·07, breadth 0·05; length of the feet 0·09.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

5. *Cortina dendroides*, n. sp.

Ring ovate, with six pairs of branched horizontal spines, three on the dorsal and three on the ventral rod. Apical horn very large, arborescent, about as long and as broad as the ring. Feet similar to the horn, also richly branched, of equal size. All the rods and their branches curved, with prominent distorted edges.

*Dimensions.*—Height of the ring 0·13 to 0·17, breadth 0·1 to 0·12; length of the feet 01·5 to 0·2.

*Habitat.*—Central Pacific, Stations 266 to 274, depth 2350 to 2925 fathoms.

6. *Cortina cervina*, n. sp. (Pl. 92, fig. 21).

Ring ovate, with four pairs of forked horizontal spines (two dorsal and two ventral pairs) Apical horn straight and stout, as long as the ring, with trifid point. Three feet equal, widely divergent, very large, branched like a deer's antler, with very numerous short and stout, curved and pointed branches. All rods and branches roundish, without edges.

*Dimensions.*—Height of the ring 0·1, breadth 0·07; length of the feet 0·12 to 0·16.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

## Genus 406. *Stephanium*,[1] n. gen.

*Definition.*—Stephanida with a simple dipleuric or bilateral ring, bearing at the base four divergent feet (two sagittal and two lateral feet).

The genus *Stephanium* differs from the preceding nearly allied *Cortina* in the production of four basal feet; the new foot, missing in the latter, is the anterior or sternal foot. Therefore *Stephanium* may be regarded as the archetype of all those NASSELLARIA in which, on the base of the sagittal ring, there are developed four typical feet—two sagittal feet (the posterior caudal and anterior sternal foot) and two lateral feet (right and left). On the origin of *Stephanium* compare above, p. 893, &c.

1. *Stephanium quadrupes*, n. sp. (Pl. 92, fig. 20).

Ring ovate, with three prominent dentate edges and a short pyramidal apical horn. Four feet all of nearly equal size, about as long as the ring, also with three thorny edges, in the upper half divergent, in the lower convergent.

*Dimensions.*—Height of the ring 0·12, breadth 0·08; length of the feet 0·11 to 0·13.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Stephanium tetrapus*, n. sp.

Ring elliptical, without edges, thorny, with a stout, thorny apical horn of the same length. Four feet curved and irregularly branched, divergent, of different size. The two sagittal feet (the anterior sternal and posterior caudal) about as long as the ring. The two lateral feet (right and left) nearly twice as long, more richly branched.

*Dimensions.*—Height of the ring 0·16, breadth 0·11; length of the feet 0·15 to 0·3.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

[1] *Stephanium*=Small crown or garland; στεφάνιον.

## Family XLIX. SEMANTIDA, n. fam.

*Definition.*—Stephoidea with a single vertical ring (the primary sagittal ring), bearing on its base a horizontal ring (basal or cortinar ring) with two to four or more basal gates (or cortinar pores).

The family Semantida differs from the preceding Stephanida in the development of a small horizontal ring on the base of the primary vertical sagittal ring. By the crossing of these two rings a small latticed basal plate is formed, with one or two pairs of pores; rarely with a greater number of "basal pores." The production of this characteristic "basal plate" is of the greatest morphological importance, as the beginning of the numerous different lattice-formations, which are differentiated in the great majority of NASSELLARIA.

In my Prodromus (1881, p. 446) I had enumerated the Semantida with three genera (Nos. 298 to 300) as a separate subfamily of the Dyostephida or "Stephoidea biannularia," and characterised these "Dyostephanida" by the following definition: "Skeleto annulis duobus composito, qui in duobus planis invicem perpendicularibus jacent; altero annulo (sagittali) verticali, altero (basali) horizontali." As the names there given were already employed with another signification, and as the Zygostephanida (there united with the Dyostephanida) are more closely related to the Coronida, I now change the names, and propose to call the family Semantida, expressing by this term the typical similarity of the skeleton to a signet-ring (*Semantis*, *Semantrum*, *Semantidium*).

At about the same time, some Stephoidea of this family were accurately described by Bütschli (1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 495, Taf. xxxii. figs. 6, 7, 8). He called them *Stephanolithis*, a name which Ehrenberg had employed, not for complete shells of Radiolaria, but for isolated parts of such, and for siliceous fragments of different skeletons, needles of Sponges, &c. The three species described by Bütschli represent three different genera of our Semantida, viz., *Semantis spinescens* (with two gates in the basal plate), *Semantrum mülleri* (with four gates), and *Semantidium haeckelii* (with six gates). He pointed out the great morphological value of the fenestrated basal plate and its paired gates, as beginnings of numerous other NASSELLARIA. But his opinion, that in all Spyroidea and Cyrtoidea, derived from these, two pairs of basal gates were constant, was erroneous, nor was the formation of the first pair naturally explained; he supposed that the formation of the basal plate begins by development of an odd sagittal apophysis, arising from the base of the primary sagittal ring. But this odd sagittal apophysis ("der unpaare mediane Kieselfortsatz $c1''$, *loc. cit.*, p. 497) is in reality not a primary

and essential part of the skeleton, but secondary and of little morphological value, absent in the majority of the Semantida and of the other NASSELLARIA.

We divide our family Semantida into two different subfamilies, which possibly possess a direct phylogenetic relation to the two subfamilies of Stephanida:—The Semantiscida have no typical feet, and have arisen directly from the Lithocircida; the Cortiniscida, however, possess the three typical basal feet of *Cortina*, and may therefore be derived directly from the Cortinida. Since these three cortinar feet are probably identical with the three primary radial rods of the P l e c t o i d e a, an immediate affinity also to these NASSELLARIA is indicated.

The Semantiscida, which do not possess these three basal cortinar feet, are the simpler forms of the family. The simplest of all, and perhaps the common ancestral form of the whole family, is *Semantis* (Pl. 92, figs. 1, 2). It may be derived from *Archicircus* or *Zygocircus* by development of two pairs of horizontal apophyses on its base, around the porochora of the central capsule. The two rods of each side (right and left), becoming curved one towards the other, and meeting laterally, form a simple horizontal gate, and the two paired basal gates together, a horizontal ring or basal ring, to which the primary sagittal ring is perpendicular. In the next allied genus, *Semantrum* (Pl. 92, figs. 3–5), three pairs of horizontal apophyses are developed, and therefore two pairs of basal gates produced, an anterior and a posterior. In the third genus, *Semantidium* (Pl. 92, figs. 6, 7), three pairs of basal pores or gates are visible, surrounded and separated by four pairs of horizontal apophyses, which arise from the base of the sagittal ring. Finally, in *Clathrocircus* (Pl. 92, figs. 8–10) the number of apophyses is much increased, and two parallel rows of pores are developed along the two sides of the sagittal ring.

The basal plate or the "seal," developed from the base of the primary sagittal ring or "signet-ring," is therefore a horizontal ring, which becomes bisected by the latter, and exhibits either one pair of primary "basal gates" or two or three pairs of these important basal pores, rarely more. Since these pores possess the greatest morphological value, and are probably everywhere homologous, we give to them and to the separating apophyses certain names, and call the anterior pair of gates, "jugular pores" (*i* in our figures, the pair I of Bütschli); the middle (usually the largest) pair, "cardinal pores" (*k* in our figures, the pair II of Bütschli), and the posterior, smaller pair, "cervical pores," *l*. The typical pairs of rods, by the union of which these basal pores arise, are the following:—(1) the clavicular or furcular rods, *f*, the first pair (rods *e*1 of Bütschli), (2) the coracal rods, *e*, between the jugular and cardinal pores (rods *e* of Bütschli), (3) the scapular rods, *g*, between the cardinal and cervical pores (rods *e*2 of Bütschli), (4) the cervical rods, the fourth pair of apophyses, the most posterior, *h*. Bütschli supposes that the topographical succession of the three typical pairs of basal pores is also the chronological succession, the jugular being formed first, the

cardinal second, and the cervical pores third; but it seems that this succession is often altered, and that the cardinal pores (the largest), appear first, the jugular pores (in front of them) second, and the cervical pores third (or perhaps sometimes in the inverse succession).

The Cortiniscida, the second subfamily of Sémantida, differ from the preceding Semantiscida in the possession of three typical basal feet, which are probably inherited from the Cortinida, and perhaps indirectly from the Plagonida (*Plagoniscus*). The simplest and the most important form of this second family is *Cortiniscus* (Pl. 92, figs. 11–13), differing from its probable ancestral form, *Cortina*, in the development of a basal ring, produced by horizontal union of the basal apophyses. The three typical feet are the same as in all triradiate NASSELLARIA, two paired pectoral feet ($p_1$, $p_{11}$) diverging on the anterior base of the sagittal ring, whilst the odd caudal foot ($c$) lies on its posterior base in the sagittal plane and appears as a basal prolongation of the dorsal rod of the sagittal ring; the upper part of the dorsal rod is usually prolonged into an ascending apical horn. In *Stephaniscus* (Pl. 92, figs. 14, 15) four basal feet are visible, an anterior or sternal foot ($z$) being added as a prolongation of the basal rod of the ring, opposite to the caudal foot. Finally, *Semantiscus* (Pl. 92, figs. 16–18) is distinguished by the possession of six divergent basal feet, probably identical with those of all six-radiate NASSELLARIA; three of these may be regarded as primary and perradial, the odd caudal and the paired pectoral feet; the three other intercalated as secondary or interradial feet, the odd sternal ($z$) and the paired tergal feet ($t_1$, $t_{11}$).

The basal plate of these Cortiniscida exhibits the same important differences as in the preceding Semantiscida, either one, or two, or three pairs of basal gates being developed. But there occur also in some species (mainly in *Cortiniscus*) only three basal gates, an odd anterior (between the two pectoral feet and a connecting horizontal bar), and two paired posterior (between the two pectoral and the odd caudal foot). It requires further accurate researches to solve the important problem, what the true homologies of these typical basal pores and the separating bars are in the different genera of Semantida. In *Semantiscus* there are three pairs of basal pores in the horizontal seal, corresponding to those of *Semantidium*, and the radial rods or bars between these are the basal parts of the six radial feet; therefore the odd caudal foot ($t$) seems to be the posterior, and the odd sternal foot ($z$) the anterior prolongation of the basal part of the primary sagittal ring; the two paired anterior or pectoral feet ($p_1$, $p_{11}$) the prolongations of the coracal rods ($e$) and the two paired posterior or tergal feet ($t_1$, $t_{11}$), the prolongations of the scapular rods ($g$). But it is not yet certain whether these six radial feet and the separating gates of the basal plate are all the same and truly homologous in all six-radiate NASSELLARIA. In every case the comparative study of the Semantida is of the highest value for the accurate knowledge of the MONOPYLEA.

*Synopsis of the Genera of Semantida.*

| | | | |
|---|---|---|---|
| I. Subfamily Semantiscida. Basal ring without typical, regularly disposed basal feet (no cortinar feet). | Only two, four, or six basal pores (no dorsal and ventral pores). | Two basal pores, | 407. *Semantis.* |
| | | Four basal pores, | 408. *Semantrum.* |
| | | Six basal pores, | 409. *Semantidium.* |
| | Besides four basal pores, also apical pores or dorsal and ventral pores along the whole ring, | | 410. *Clathrocircus.* |
| II. Subfamily Cortiniscida. Basal ring with typical, regularly disposed basal feet (cortinar feet). | Three basal feet. | One odd caudal foot and two paired lateral feet, | 411. *Cortiniscus.* |
| | Four basal feet. | Two sagittal and two lateral or pectoral feet, | 412. *Stephaniscus.* |
| | Six basal feet. | Two sagittal, two pectoral, and two tergal feet, | 413. *Semantiscus.* |

## Subfamily 1. SEMANTISCIDA, Haeckel.

*Definition.*—Semantida without typical basal feet or cortinar feet.

### Genus 407. *Semantis*,[1] n. gen.

*Definition.*—Semantida with two basal pores (or jugular pores), without typical basal feet.

The genus *Semantis*, the most primitive and the oldest of the Semantida, is of the greatest morphological interest, as the first form of Stephoidea which produces gates or pores by communicating branches, and therefore the probable ancestral form not only of this family, but of the greater number of all Stephoidea, and perhaps even of all Spyroidea and Cyrtoidea. *Semantis* arises from *Archicircus* by the production of two pairs of lateral branches from the basilar rod of the sagittal ring, one anterior pair of clavicular rods, and one posterior pair of coracal rods. By junction of the clavicular and coracal rod on each side arises a left and a right pore, the "jugular pore or jugular gate."

1. *Semantis biforis*, n. sp. (Pl. 92, fig. 2).

Sagittal ring obliquely ovate, nearly trapezoidal, with six pairs of short mammillated knobs or branches; dorsal rod straight, vertical, with two pairs of knobs, ventral rod strongly convex, also with

[1] *Semantis* = Signet-ring ; σημαντίς.

two pairs of knobs; two other pairs in the apical rod. Basilar rod horizontal, straight. Basal ring with six pairs of similar knobs, three on each side. Basal gates ovate or nearly triangular.

*Dimensions.*—Height of the sagittal ring 0·09, breadth 0·07.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

2. *Semantis distoma*, n. sp.

Sagittal and basal ring nearly of the same form as in the preceding species, but half as thick and armed with numerous branched spines which are about half as long as the diameter of the main gate, and with thin and curved pointed branches.

*Dimensions.*—Height of the sagittal ring 0·11, breadth 0·08.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

3. *Semantis dipyla*, n. sp.

Sagittal ring kidney-shaped, very thick, with six pairs of short, thorny, or irregularly tuberculated knobs (two dorsal, two apical, and two ventral pairs). Basal ring smooth, scarcely half as thick, horizontal, with two semicircular basal gates, about half as broad as the main gate. From the two opposite lateral corners of the basal ring two slender upwardly curved spines arise, resembling the basal part of a commencing frontal ring.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·05.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

4. *Semantis sigillum*, n. sp. (Pl. 92, fig. 1).

Sagittal ring elliptical, with four pairs of stout arborescent spines (two apical and two equatorial pairs), which are irregularly branched and forked, with numerous thin lateral branches. Apex with a short conical trifid vertical horn. Basal ring thorny, with obliquely descending slightly curved bars.

*Dimensions.*—Height of the sagittal ring 0·12, breadth 0·09.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

5. *Semantis distephanus*, n. sp. (Pl. 83, fig. 3).

Sagittal ring thin, semicircular, smaller than the thin basal ring, which exhibits two semicircular gates. Both rings are armed with numerous small spines of equal size, which on the former are arranged in two, on the latter in three regular rows. (The basal rod of the sagittal ring, separating the two basal gates, in fig. 3 is, by mistake, not distinctly enough drawn.)

*Dimensions.*—Height of the sagittal ring 0·06, breadth 0·08.

*Habitat.*—Tropical Atlantic, Station 348, surface.

6. *Semantis spinescens*, Haeckel.

*Stephanolithis spinescens*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 160, Taf. i. fig. 29.

*Stephanolithis spinescens*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 497, Taf. xxxii. figs. 7*a*, 7*b*.

Sagittal ring ovate, with four pairs of thin, irregularly branched spines, two apical pairs, one on the straight dorsal rod, and one on the curved ventral rod. Basilar rod with a posterior and an anterior forked rod (commencing caudal and sternal foot). Basal ring square, with two lateral spines, and two triangular gates scarcely one-third as broad as the ring-gate. An internal ascending procolumna (rod $c_1$ in the figure of Bütschli) connects the basal and ventral rods of the sagittal ring.

*Dimensions.*—Height of the sagittal ring 0·1, breadth 0·07.

*Habitat.*—Fossil in Barbados.

## Genus 408. *Semantrum*,[1] n. gen.

*Definition.*—Semantida with four basal pores (two anterior jugular and two posterior cardinal pores), without typical basal feet.

The genus *Semantrum*, one of the most important of the NASSELLARIA, arises from the preceding *Semantis* by duplication of the two basal gates. Behind the pair of coracal rods there arises from the basilar rod of the sagittal ring a third pair of lateral horizontal branches, the scapular rods. These become connected with the coracal rods on each side, and so produce a second posterior pair of basal pores, the "cardinal gates." These are constantly larger than the anterior "jugular gates." Therefore the vertical ring of *Semantrum* possesses a horizontal basal ring with four very characteristic gates, enclosed by three pairs of lateral curved and connected branches, and these become transmitted by heredity to the majority of the NASSELLARIA.

1. *Semantrum quadrifore*, n. sp. (Pl. 92, fig. 5).

Sagittal ring subcircular or ovate, with three edges and four sagittal forked spines on the odd edge (two dorsal and two ventral spines). Basal ring decagonal, with ten simple or forked spines on the ten corners. Jugular gates tetragonal. Cardinal gates pentagonal.

*Dimensions.*—Height of the sagittal ring 0·09, breadth 0·07.

*Habitat.*—Tropical Atlantic, Station 351, surface.

[1] *Semantrum* = Signet-ring; σήμαντρον.

2. *Semantrum tetrastoma*, n. sp. (Pl. 92, fig. 3).

Sagittal ring semicircular, thorny, without edges. Basal ring tetragonal or nearly cordate, with a small anterior and a large posterior bow-shaped incision; on the lateral edges with numerous irregular thorns. Jugular gates pear-shaped. Cardinal gates nearly kidney-shaped.

*Dimensions.*—Height of the sagittal ring 0·1 to 0·14, breadth 0·07 to 0·09.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

3. *Semantrum tetrapylum*, n. sp.

Sagittal ring elliptical, tuberculate. Basal ring trapezoidal, also with roundish thick rods and small irregular tubercles on the margin. Jugular gates ovate, two-thirds as broad as the triangular cardinal gates.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·05.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

4. *Semantrum mülleri*, Haeckel.

*Stephanolithis mülleri*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 499, 539, Taf. xxxii. figs. 8*a*, 8*b*, 8*c*.

Sagittal ring nearly semicircular or obliquely ovate, thorny. Basal ring also nearly semicircular, with two slight sagittal incisions (one anterior and one posterior), on the lateral edges with numerous small thorns. Jugular pores (pair I of Bütschli) pear-shaped. Cardinal pores (pair II. of Bütschli) triangular. Sometimes (but not constantly) a pair of cervical bows connects the scapular bars with the subvertical dorsal rod of the sagittal ring.

*Dimensions.*—Height of the sagittal ring 0·09, breadth 0·06.

*Habitat.*—Fossil in Barbados.

5. *Semantrum sphragisma*, n. sp.

Sagittal ring circular, smooth. Basal ring also nearly circular and smooth; its four basal gates of nearly equal size, elliptical or subcircular; the jugular pores scarcely smaller than the cardinal pores. All rods smooth, cylindrical, without edges and thorns.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·07.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms; also fossil in Barbados.

6. *Semantrum bütschlii*, n. sp.

Sagittal ring triangular, with vertical straight ascending dorsal rod, horizontal straight basilar rod and obliquely ascending, slightly curved ventral rod; all rods nearly cylindrical, with irregular

branched thorns and distorted edges. Jugular pores triangular, scarcely half as broad as the large semicircular cardinal pores.

*Dimensions.*—Height of the sagittal ring 0·11, breadth 0·08.

*Habitat.*—Fossil in Barbados.

7. *Semantrum signarium*, n. sp. (Pl. 92, fig. 4).

Sagittal ring obliquely ovate, thorny. Basal ring kidney-shaped or nearly pentagonal, with broad concave dorsal incision and five larger branched spines on the five corners; between them smaller thorns. Jugular gates pear-shaped, scarcely half as broad as the triangular cardinal gates.

*Dimensions.*—Height of the sagittal ring 0·12, breadth 0·09.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 409. *Semantidium*, n. gen.

*Definition.*—Semantida with six basal pores (two anterior jugular, two middle cardinal, and two posterior cervical pores), without typical basal feet.

The genus *Semantidium* exhibits a further developmental stage of the basal plate of the Semantida. Whilst this plate in *Semantis* possesses one pair of basal pores, and in *Semantrum* two pairs, here in *Semantidium* it has three pairs. The new third pair is produced on the dorsal edge of the basal plate, which becomes connected with the basal part of the dorsal rod of the sagittal ring by a pair of cervical rods. The middle pair of pores (the cardinal) are always larger than the anterior (jugular) and the posterior (cervical pores). The same form of basal plate is preserved in numerous Spyroidea and Cyrtoidea, as a "cortinar septum with six collar pores," (*e.g.*, Pl. 53, fig. 18).

1. *Semantidium hexastoma*, n. sp. (Pl. 92, fig. 6).

Sagittal ring ovate, thorny. Basal ring rhombic or nearly square, with four short conical descending spines on the four prominent edges (two sagittal and two lateral); between them numerous smaller irregular thorns. Jugular and cervical gates nearly equal, ovate, half as broad as the triangular cardinal gates between them.

*Dimensions.*—Height of the sagittal ring 0·14, breadth 0·1.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Semantidium sexangulum*, n. sp.

Sagittal ring ovate, with six pairs of short branched thorns (two apical, two dorsal, and two ventral). Basal ring hexagonal, with three pairs of short branched thorns on the six corners (one

[1] *Semantidium*=Small signet-ring; σημαντίδιον.

sagittal pair, one posterior and one anterior). All six gates of the basal plate triangular, the jugular and cervical a little smaller than the cardinal gates.

*Dimensions.*—Height of the sagittal ring 0·1, breadth 0·07.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

3. *Semantidium haeckelii*, Bütschli.

*Stephanolithis Haeckelii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 499, 538, Taf. xxxii. figs. 6*a*, 6*b*.

Sagittal ring elliptical, with three pairs of short horizontal branched spines, one apical and two equatorial pairs (one dorsal and one ventral). Basal ring roundish hexagonal, with numerous short thorns on the margin. Jugular pores ovate, about half as broad as the ovate cardinal pores and twice as broad as the small cervical pores.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·06.

*Habitat.*—Fossil in Barbados.

4. *Semantidium signatorium*, n. sp. (Pl. 92, fig. 7).

Sagittal ring semicircular, thorny; basal ring pentagonal, with short spines on the margin and five stronger thorny spines on the five corners. Jugular pores ovate, smaller than the triangular cervical pores. Cardinal pores two to three times as large as each of the former, pentagonal.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·12.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

Genus 410. *Clathrocircus*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Semantida with a variable number of pores on the apical and the basal part of the ring, symmetrically arranged, without typical basal feet.

The genus *Clathrocircus* comprises those Semantida in which the sagittal ring bears not only basal pores (as in the three preceding genera) but also apical pores (on the opposite pole of the main axis), or a variable number of pores along the whole ring. All these pores are symmetrically arranged in pairs. In the simplest form there are only two apical pores opposite to four basal pores, whilst in the highest state of development the whole ring bears two complete circles of pores. At both poles of the transverse axis two large lateral gates remain open. If these become closed by lattice-work, *Clathrocircus* passes over into *Dictyospyris*.

[1] *Clathrocircus* = Lattice-ring; κλῆθρον, κίρκος.

1. *Clathrocircus hexaporus*, n. sp.

Sagittal ring circular, smooth, with three pairs of pores (one apical and two basal). The two apical pores are triangular, with two lateral spines, and correspond to the two mitral gates of the Tympanida. The four basal pores form a hexagonal basal plate, with six lateral spines, and correspond to the four basal pores of *Semantrium;* the two jugular are pear-shaped, and half as broad as the two triangular cardinal pores.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·06.

*Habitat.*—Cosmopolitan; Atlantic, Pacific, many Stations, surface.

2. *Clathrocircus octoporus*, n. sp.

Sagittal ring elliptical, smooth, with four pairs of pores (two apical and two basal). The four apical pores are of nearly equal size, subcircular, and form a regular cross around the apical pole. The four basal pores are ovate, and form a quadrangular plate, armed with marginal thorns; the two jugular pores are somewhat smaller than the two cardinal pores.

*Dimensions.*—Height of the sagittal ring 0·11, breadth 0·08.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

3. *Clathrocircus decaporus*, n. sp.

Sagittal ring ovate, thorny, with five pairs of pores (two apical and three basal). The four apical pores are roundish and form a cross. The six basal pores are triangular and form a hexagonal plate with thorny margin; the two jugular pores are somewhat larger than the two cervical, and half as broad as the two cardinal pores.

*Dimensions.*—Height of the sagittal ring 0·09, breadth 0·07.

*Habitat.*—North Pacific, Station 256, depth 2950 fathoms.

4. *Clathrocircus stapedius*, n. sp. (Pl. 92, fig. 8).

Sagittal ring ovate, smooth, with six pairs of pores (two apical and four basal). The four apical pores are of nearly equal size and form a quadrangular mitral plate with two large lateral horns. The eight basal pores are of very different size (the four central far larger than the two anterior and the two posterior), and form a hexagonal basal plate, also with two large lateral horns. The four branched lateral horns (two upper and two lower) form together an incomplete frontal ring.

*Dimensions.*—Height of the sagittal ring 0·1, breadth 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

5. *Clathrocircus dictyospyris*, n. sp. (Pl. 92, fig. 9).

Sagittal ring ovate, thorny, with eight pairs of pores. The four apical and the four basal pores are elliptical and far larger than the four dorsal and the four ventral pores. Resembles a *Dictyospyris* with open lateral gates.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·06.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

6. *Clathrocircus multiforis*, n. sp. (Pl. 92, fig. 10).

Sagittal ring circular, smooth, with ten to twelve pairs of roundish pores, forming together a complete lattice-girdle with two parallel circular rows of pores. Four larger of these are the four gates of the basal ring (two jugular and two cardinal pores).

*Dimensions.*—Diameter of the ring 0·1 to 0·15, breadth 0·03 to 0·05.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

## Subfamily 2. CORTINISCIDA, Haeckel.

*Definition.*—Semantida with large, typical, regularly disposed basal feet (originally three cortinar feet, one odd caudal and two paired pectoral).

### Genus 411. *Cortiniscus*,[1] n. gen.

*Definition.*—Semantida with three typical basal feet (an odd caudal foot and two paired lateral or pectoral feet).

The genus *Cortiniscus* is of peculiar importance, as the common ancestral form of the *Cortiniscida*, or those Semantida in which the basal ring is provided with typical, regularly disposed basal feet—three, four, or six. Since these typical basal feet (or "cortinar feet") are preserved in the greater number of all NASSELLARIA, determining their triradial structure, they possess a great morphological value. *Cortiniscus* exhibits the same three primary feet as *Cortina*, from which it differs in the production of two or more basal pores (between the odd caudal and the paired lateral feet).

1. *Cortiniscus tripodiscus*, n. sp. (Pl. 92, fig. 11).

Sagittal ring ovate, thorny, with three prominent, distorted edges; its dorsal rod nearly straight and vertical, with one or two pairs of short thorns; its ventral rod strongly curved, with three or four pairs of divergent thorns. Basal ring larger than the sagittal ring, with two semicircular gates and obliquely ascending halves, which on the inner and lower edge are smooth,

[1] *Cortiniscus*=Small cortina or tripod.

on the outer and upper thorny. Apical horn and the three divergent feet nearly equal, straight, about as long as the sagittal ring, with three thorny edges.

*Dimensions.*—Height of the sagittal ring 0·1 to 0·12, breadth 0·07 to 0·09.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

2. *Cortiniscus dipylaris*, n. sp. (Pl. 92, fig. 13).

Sagittal ring nearly semicircular, with prominent distorted edges and six pairs of small roundish papillate tubercles (three pairs on the straight dorsal, three on the curved ventral rod). Apical horn short and stout, with a tuberculate knob. Basal ring smaller than the sagittal ring with two elliptical gates. Three feet short and stout, irregularly branched like a cauliflower, with numerous short papillate tubercles.

*Dimensions.*—Height of the sagittal ring 0·11, breadth 0·08.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Cortiniscus tripylaris*, n. sp.

Sagittal ring elliptical, smooth. Apical horn conical, smooth. Basal ring larger than the sagittal ring, with three elliptical gates of equal size; two paired, posterior (jugular pores) between the basal parts of the caudal foot and the two pectoral feet), and an odd, anterior (sternal pore) between the basal parts of the two pectoral feet and a connecting horizontal convex sternal bow.

*Dimensions.*—Height of the sagittal ring 0·09, breadth 0·06.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

4. *Cortiniscus tetrapylaris*, n. sp.

Sagittal ring elliptical, with four pairs of short branched thorns, two posterior on the straight dorsal, and two anterior on the curved ventral rod. Basal ring smaller than the sagittal ring, with four triangular gates; the two anterior (jugular pores) a little smaller than the two posterior (cardinal pores). Apical horn and the three divergent feet shorter than the sagittal ring, irregularly branched, with curved, often tuberculate branches.

*Dimensions.*—Height of the sagittal ring 0·08 to 0·012, breadth 0·06 to 0·1.

*Habitat.*—Fossil in Barbados.

5. *Cortiniscus typicus*, n. sp. (Pl. 92, fig. 12).

Sagittal ring ovate, thorny, with three distorted edges; dorsal rod nearly straight and vertical prolonged upwards into a stout thorny apical horn, downwards into the caudal foot. Basal ring smaller than the sagittal ring, with four elliptical or nearly triangular gates; the two anterior (jugular pores) about half as large as the two posterior (cardinal pores). Three feet of equal size, thorny, divergent, straight or slightly curved, about as long as the diameter of the sagittal ring.

*Dimensions.*—Height of the sagittal ring 0·14 to 0·18, breadth 0·1 to 0·12.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, at various depths.

## Genus 412. *Stephaniscus*,[1] n. gen.

*Definition.*—Semantida with four typical basal feet (two sagittal and two lateral or pectoral feet).

The genus *Stephaniscus* differs from the preceding *Cortiniscus* in the production of a fourth (sternal) foot, and therefore exhibits the same relation to it that *Stephanium* among the Stephanida bears to *Cortina*. It differs from *Stephanium* in the production of a basal ring, with pores or gates between the bases of the basal feet. Two of these feet are sagittal (the posterior caudal and the anterior sternal foot), whilst the other two are lateral or pectoral (right and left). The basal lattice-plate exhibits either two pores ("jugular gates") or four pores (two anterior jugular and two posterior cardinal gates).

### 1. *Stephaniscus tetrapodius*, n. sp.

Sagittal ring nearly circular, smooth, with a short conical apical horn. Basal ring square, smooth, with two triangular gates. Four feet simple, equal, conical, divergent, about as long as the diameter of the ring.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·07.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

### 2. *Stephaniscus quadrifurcus*, n. sp. (Pl. 92, fig. 14).

Sagittal ring subcircular, thorny, with a small thorny apical horn. Basal ring also nearly circular, with two large semicircular gates and a few small thorns. All four feet curved and forked, the fork-branches again ramified, with numerous short curved and pointed branches. The two lateral feet (right and left) are larger and more branched than the two sagittal feet (sternal and caudal foot).

*Dimensions.*—Height of the sagittal ring 0·12, breadth 0·1.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### 3. *Stephaniscus quadrigatus*, n. sp. (Pl. 92, fig. 15).

Sagittal ring oblique, ovate, with three prominent thorny edges; its dorsal rod nearly straight and vertical, the ventral rod strongly curved; apex with a small curved horn. Basal ring with a few short thorns and four gates of different size; the two anterior (jugular pores) ovate or nearly triangular, two-thirds as broad as the two posterior subcircular or pentagonal (cardinal pores). All

[1] *Stephaniscus* = Small coronet or garland; στεφανίσκος.

four feet simple, curved, with three edges, the posterior (caudal) foot larger, the anterior (sternal) foot smaller than the two lateral (pectoral) feet.

*Dimensions.*—Height of the sagittal ring 0·09, breadth 0·07.

*Habitat.*—Tropical Atlantic, Station 351, surface.

4. *Stephaniscus medusinus*, n. sp.

Sagittal ring elliptical, thorny, with a larger apical horn. Basal ring nearly square, with short marginal thorns and four large ovate gates of nearly equal size. All four feet of equal size divergent, curved, irregularly branched, with short curved branches.

*Dimensions.*—Height of the sagittal ring 0·13, breadth 0·09.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

## Genus 413. *Semantiscus*,[1] n. gen.

*Definition.*—Semantida with six typical basal feet (two sagittal, two pectoral, and two tergal feet).

The genus *Semantiscus* may be the archetype of those NASSELLARIA which exhibit six typical basal feet, in combination with the sagittal ring. Three of these are the primary feet of *Cortina* and *Cortiniscus*, the other three are secondary productions between the former. The basal ring may possess either two, four, or six basal pores.

1. *Semantiscus hexapodius*, n. sp. (Pl. 92, fig. 16).

Sagittal ring elliptical, with a large branched apical horn. Basal ring small, square, with two small triangular gates (or jugular pores). From its periphery there arise six short and stout cylindrical feet, one very large (caudal) from the posterior corner, two tergal on each side, two opposite (pectoral) from the lateral corners, and one odd sternal from the anterior corner. All six spines bear a bunch of ten to twenty stout pointed conical branches, partly simple, partly forked.

*Dimensions.*—Height of the sagittal ring 0·12, breadth 0·08.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Semantiscus hexaspyris*, n. sp. (Pl. 92, fig. 18).

Sagittal ring semicircular, broad, latticed, with two pairs of irregular dorsal and two pairs of ventral pores. The dorsal rod is straight and vertical, prolonged upwards into a short serrate apical horn, downwards into a straight linear caudal foot. The ventral rod is curved and prolonged into a similar sternal foot. Basal ring hexagonal, with four ovate gates (two smaller jugular and two larger cardinal pores); its four lateral corners prolonged into four curved thorny lateral feet (two

[1] *Semantiscus* = Small signet-ring; σημαντικος.

anterior larger pectoral, and two posterior smaller tergal feet). This species may be regarded as a commencing *Hexaspyris* or *Liriospyris*.

*Dimensions.*—Height of the sagittal ring 0·08, breadth 0·06.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Semantiscus hexapylus*, n. sp. (Pl. 92, fig. 17).

Sagittal ring ovate, thorny, with a small apical horn. Basal ring with six roundish or nearly triangular gates; the two jugular pores are smaller than the two cardinal and larger than the two cervical pores. The separating bars between these six pores are prolonged into six straight, thorny widely divergent feet; three larger feet (the caudal and the two pectoral) with a pair of apophyses three smaller between them simple (the sternal and the two tergal feet).

*Dimensions.*—Height of the sagittal ring 0·13, breadth 0·09.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Family L. Coronida, Haeckel.

*Triostephida*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Stephoidea with two crossed vertical rings, perpendicular one to the other (the primary sagittal and the secondary frontal ring). Usually their common base bears a horizontal basal ring, but a mitral ring (or a horizontal ring at the apex) is never developed.

The family Coronida comprises those Stephoidea in which the primary sagittal ring (of the Stephanida and Semantida) becomes crossed by a second vertical ring, the lateral or frontal ring. Between these two vertical meridian rings, perpendicular to one another, four large apertures remain constantly open, the "lateral" gates. But besides these four constant openings, usually (excepting only in the Zygostephanida) other gates are developed on the common base of the two crossed rings, produced by a third, horizontal, basal ring. These basal gates are the same which we have found already in the Semantida.

The distinction of the Coronida from the other Stephoidea is always easy. In the Stephanida and Semantida, the frontal ring, or the second meridian ring, which we find in all Coronida, is never developed. On the other hand these latter never exhibit the typical "mitral ring," or the second, upper, horizontal ring, which distinguishes the Tympanida.

We distinguish here, among the Coronida, four different subfamilies, which perhaps afterwards may be better separated as families. Of these four groups the Zygostephanida and Acanthodesmida exhibit the nearest relationship to the Stephanida, whilst the Eucoronida and Trissocyclida possess a closer affinity with the Semantida.

The Zygostephanida, constituting the first subfamily, exhibit four large gates only, and differ from all other Coronida in the absence of a basal ring and of basal gates. Therefore the skeleton is entirely composed of two crossed vertical rings, perpendicular to one another; the first is the primary or sagittal ring (inherited from the Stephanida), the second is the new lateral or frontal ring. The four large lateral gates are either quite simple (*Zygostephanus*) or partly closed by loose and irregular lattice-work (*Zygostephanium*). The Zygostephanida may be derived directly from the Stephanida by development of lateral branches forming a frontal ring. They commonly possess the same characteristic spines or branches, and the same typical difference between the straight dorsal rod and convex ventral rod of the sagittal ring, which we found in the greater number of Stephanida. The frontal ring is commonly elliptical or kidney-shaped, and much larger than the ovate sagittal ring.

The Acanthodesmida, forming the second subfamily of Coronida, differ from all other members of this family in the possession of a large simple basal gate, surrounded by a simple horizontal basal ring. Only this ring is complete, whilst the two crossed vertical meridian rings (the primary sagittal and the secondary frontal ring) are incomplete, both truncated at the base by the basal ring. Therefore there remain here between the three rings five large gates (recognised previously by Johannes Müller in 1856 in *Acanthodesmia*): four lateral gates (the same as in the Zygostephanida) and one central basal gate. The latter is always quite simple, and serves for the emission of the pseudopodia, arising from the basal pole of the central capsule. The four lateral gates are either quite simple (*Coronidium*) or partly closed by irregular loose lattice-work (*Acanthodesmia*). The subfamily Acanthodesmida may be derived either directly from the Stephanida (by development of a central basal gate) or from the Eucoronida (by loss of the basilar part of the sagittal ring).

The Eucoronida, the third subfamily, are the most important group of the Coronida; their numerous species are much more frequent and more widely distributed than those of the other three subfamilies. They may be derived immediately from the Semantida by the development of a lateral or frontal ring. This remains incomplete in the basal part, whilst the two other rings, perpendicular to it (the vertical sagittal ring and the horizontal basal ring), are complete. Therefore the shell constantly exhibits six large open gates between the three rings; four lateral gates (the same as in the Zygostephanida and Acanthodesmida) and two basal gates (inherited from *Semantis*); the latter correspond to the "jugular pores" of the Spyroidea and Cyrtoidea; they remain constantly simple. The four lateral gates may also remain simple (*Eucoronis*) or they may become partly closed by irregular loose lattice-work (*Plectocoronis*). The remarkable genus *Podocoronis* is distinguished by the development of typical descending basal feet, which are regularly disposed and correspond to the typical "cortinar feet" of the other NASSELLARIA. There may be developed either two lateral feet (as lower

prolongations of the segments of the frontal ring), or three feet (one caudal and two pectoral, as in *Cortina* and *Cortiniscus*), or four feet (two sagittal and two lateral, as in *Stephanium* and *Stephaniscus*), or six feet (two sagittal, two pectoral, two tergal, as in *Semantiscus*), sometimes numerous feet (as in *Petalospyris* and *Anthocyrtis*, &c.).

The Trissocyclida represent the fourth and last subfamily of Coronida, distinguished from all others in the possession of three complete rings, perpendicular one to another, and of eight large gates separated by them. Two of the three rings are vertical (the primary sagittal and the secondary frontal ring), the third is horizontal (the basal ring). The four upper gates correspond to the four lateral gates of the preceding three subfamilies; the four lower gates are the same as the four basal gates of *Semantrum* (two primary jugular and two secondary cardinal gates); therefore the Trissocyclida may be derived directly from these Semantida by development of a complete frontal ring. Probably the two jugular gates were originally smaller than the two cardinal, but usually they have become equal. In *Tristephanium* (the common ancestral form of the Trissocyclida) and in the closely allied *Tricyclidium* the four basal gates remain smaller than the four lateral gates. But in two other genera, *Trissocircus* and *Trissocyclus*, the four lower or basal gates reach the same size as the four upper or lateral gates; therefore all eight gates become equal and the basal ring becomes equatorial. In the most regular species of the latter genera also the three rings become perfectly equal and cannot be any longer distinguished. Here the original bilateral (or dipleurie) fundamental form of the shell passes over into a regular cubic or octahedral form (with three equal, isopolar axes, perpendicular one to another). The eight large gates of the Trissocyclida usually remain simple (*Tristephanium, Trissocircus*), but sometimes they become partly closed by loose lattice-work (*Tricyclidium, Trissocyclus*).

The original rings, and the secondary rods or bars, composing the loose framework of the Coronida are either roundish (with circular or elliptical transverse section) or three-edged (with triangular transverse section), rarely quadrangular or provided with distorted edges. The branches or spines arising from them, are either simple or branched, and offer a great variety in number, form, and disposition. The most important forms are those which develop the three typical basal feet of *Cortina*, *e.g.*, *Podocoronis cortina* (Pl. 97, fig. 2).

*The Central Capsule* of the Coronida is the same as in the other Stephoidea (comp. p. 937), and offers all those characteristic peculiarities of "Monopylea" which we have mentioned above in the general description of the NASSELLARIA (p. 890). Usually it is spherical or ellipsoidal, often violin-shaped or bilobed, with a sagittal constriction. The porochora of its basal pole is in close contact with the base of the sagittal ring.

*Synopsis of the Genera of Coronida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Zygostephanida. Four lateral gates (no basal gate). | Two meridional rings (sagittal and frontal) complete, perpendicular to one another (no basal ring). | Four lateral gates simple, | | 414. *Zygostephanus.* |
| | | Four lateral gates partly latticed, | | 415. *Zygostephanium.* |
| II. Subfamily Acanthodesmida. Five large gates (four lateral and one simple basal). | Two meridional rings (sagittal and frontal) incomplete, both truncated by the complete horizontal basal ring. | Four lateral gates simple, | | 416. *Coronidium.* |
| | | Four lateral gates partly latticed, | | 417. *Acanthodesmia.* |
| III. Subfamily Eucoronida. Six large gates (four lateral and two basal). | Two rings (the sagittal meridional ring and the horizontal basal ring) complete, the frontal meridian ring incomplete. | Basal ring without larger descending feet. | Gates simple, | 418. *Eucoronis.* |
| | | | Gates partly latticed, | 419. *Plectocoronis.* |
| | | Basal ring with large, regularly disposed, descending feet. Gates simple, | | 420. *Podocoronis.* |
| IV. Subfamily Trissocyclida. Eight large gates (four upper lateral and four lower basal). | Two meridional rings (sagittal and frontal) and the horizontal basal ring complete. All three complete rings perpendicular to one another. | Four upper gates larger than the four lower. | Gates simple, | 421. *Tristephanium.* |
| | | | Gates partly latticed, | 422. *Tricyclidium.* |
| | | All eight gates of equal size. | Gates simple, | 423. *Trissocircus.* |
| | | | Gates partly latticed, | 424. *Trissocyclus.* |

Subfamily 1. ZYGOSTEPHANIDA, Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Coronida with four large lateral gates, without basal gate. Skeleton composed of two complete vertical rings, perpendicular one to another—the primary sagittal and the secondary frontal ring.

Genus 414. *Zygostephanus*,[1] Haeckel, 1862, Monogr. d. Radiol., p. 268.

*Definition.*—Coronida with four large, simple, lateral gates, without basal gate and lattice-work. Skeleton composed of two simple meridional rings, perpendicular to one another.

The genus *Zygostephanus*, founded by me in 1862 for the Mediterranean *Zygostephanus mülleri*, is the simplest and most primitive of all the Coronida, and may there-

[1] *Zygostephanus* = Yoked ring; *ζυγόν, στέφανος.*

fore be regarded as the common ancestral form of this family. The simple skeleton is composed of two meridional rings only, perpendicular one to another—a sagittal and a frontal ring.

Subgenus 1. *Zygostephus*, Haeckel, 1881, Prodromus, p. 446.

*Definition.*—The two vertical rings of nearly equal height, therefore without sagittal constriction.

1. *Zygostephanus dissocircus*, n. sp. (Pl. 93, fig. 1).

Both rings elliptical, of nearly equal height, smooth, without spines. Frontal ring somewhat longer than the sagittal. No sagittal constriction.

*Dimensions.*—Height of the rings 0·07, breadth 0·1.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, surface.

2. *Zygostephanus serratus*, n. sp.

Both rings elliptical, of nearly equal height, with a serrate prominent edge on the outer convexity (in the transverse section three-edged). No sagittal constriction.

*Dimensions.*—Height of the rings 0·08, breadth 0·12.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Zygostephanus mülleri*, Haeckel.

*Zygostephanus mülleri*, Haeckel, 1862, Monogr. d. Radiol., p. 268, Taf. xii. fig. 2.

Both rings elliptical, of nearly equal height, armed with numerous (about fifty) slender curved spines, as long as the radius of the rings; commonly each ring with twelve pairs of divergent spines. No sagittal constriction.

*Dimensions.*—Height of the rings 0·06, breadth 0·1.

*Habitat.*—Mediterranean (Messina), surface.

4. *Zygostephanus ramosus*, n. sp.

Both rings elliptical, of nearly equal height, armed with numerous branched spines, which are arranged on each ring in two divergent rows; the branches of the spines are curved and partly protect the open gates. No sagittal constriction.

*Dimensions.*—Height of the rings 0·07, breadth 0·09.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

Subgenus 2. *Zygostephaniscus*, Haeckel, 1881, Prodromus, p. 446.

*Definition.*—The two vertical rings of different heights; the frontal ring higher than the sagittal ring, therefore with a sagittal constriction in the median plane.

5. *Zygostephanus reniformis*, n. sp.

Frontal ring kidney-shaped, in the upper half convex, in the lower half concave, in the latter with a deep sagittal constriction, armed with numerous irregular short spines. Sagittal ring thicker and lower, only two-thirds as high, with four pairs of short divergent spines (two ventral and two dorsal pairs).

*Dimensions.*—Height of the frontal ring 0·13, breadth 0·2.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

6. *Zygostephanus violina*, n. sp.

Frontal ring violin-shaped, on the upper and the lower margin concave, with a deep sagittal constriction, armed with numerous irregular spines, which are partly simple, partly branched. Sagittal ring thicker and lower, only half as high, with a few short conical spines at the apical and basal poles.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·18.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

7. *Zygostephanus bicornis*, n. sp. (Pl. 93, fig. 2).

Frontal ring violin-shaped, on the upper and the lower margin concave, with a deep sagittal constriction; its two halves pentagonal. Between numerous smaller spines there arise from the frontal ring six groups of larger branched spines, two odd in the corners of the highest points (curved like two horns), two branched pairs on the prominent lateral corners (at right and left), and two pairs in the corners of the lowest points (like four branched basal feet). Sagittal ring only two-thirds as high, with four pairs of irregular spines.

*Dimensions.*—Height of the frontal ring 0·11, breadth 0·16.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

Genus 415. *Zygostephanium*,[1] Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Coronida with four large, partly latticed, lateral gates, without basal gate. Skeleton composed of two meridional rings perpendicular to each other.

The genus *Zygostephanium* differs from the preceding ancestral genus *Zygostephanus* in the development of lattice-work along the two crossed rings, produced by their anastomosing branches. Therefore the four large lateral gates between them, which are quite simple, in the preceding genus here become more or less fenestrated.

[1] *Zygostephanium*=Small yoked ring; ζυγόν, στεφάνιον.

1. *Zygostephanium dizonium*, n. sp. (Pl. 93, fig. 3).

*Tympaniscus dizonius*, Haeckel, 1882, Manuscript.

Both rings elliptical, of nearly equal height, smooth, without spines. Sagittal ring with four pairs of small pores (two apical pairs and two basal pairs). Frontal ring with three pairs of small pores (one pair lateral, one pair above and one pair below).

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·12.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

2. *Zygostephanium paradictyum*, n. sp. (Pl. 93, fig. 4).

Frontal ring kidney-shaped, in the upper half convex, in the lower concave, in the latter with a deep sagittal constriction. Sagittal ring ovate, about two-thirds as high as the frontal ring. Both rings three-edged, armed with numerous short and branched bristle-shaped spines, which anastomose along their three edges and produce two series of irregular polygonal pores.

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·13.

*Habitat.*—North Pacific, Station 236, surface.

3. *Zygostephanium constrictum*, n. sp.

Frontal ring violin-shaped, concave on the upper and lower margins, with a deep sagittal constriction. Sagittal ring ovate, about two-thirds as high as the frontal ring. Both rings covered with numerous branched irregular spines, which partly anastomose along the edges of the rings, and produce small irregular polygonal pores.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·18.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Subfamily 2. ACANTHODESMIDA, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Coronida with five large gates (four lateral and one basal). Skeleton composed of three rings, perpendicular one to another, two of which are vertical and incomplete (the primary or lateral, and the secondary or frontal), the third is horizontal and complete (the tertiary or basal ring).

### Genus 416. *Coronidium*,[1] Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Coronida with five large simple gates (four lateral and one basal). Skeleton composed of two incomplete meridional rings and one complete basal ring, without lattice-work.

[1] *Coronidium* = Small crown ; κορωνίδιον.

The genus *Coronidium* and the following, nearly allied *Acanthodesmia*, form together the peculiar subfamily of Acanthodesmida—not in the wider sense in which I first founded this group (1862, Monogr. d. Radiol., p. 265), but in the restricted sense, which is exactly defined in my Prodromus (1881, p. 445). According to this definition, the shell is composed of three different rings, perpendicular to one another; only one of these is complete, the simple horizontal basal ring; the two others are incomplete and vertical (the primary or sagittal and the secondary or frontal ring). Therefore there remain constantly between the three rings five characteristic large openings or gates; four of these are lateral (between the halves of the two meridional rings), the fifth is basal, enclosed by the horizontal basal ring. The longest known type of this subfamily is *Acanthodesmia vinculata*, the five characteristic gates of which are clearly distinguished by its discoverer, Johannes Müller ("Das Gehäuse besteht nur aus den Leisten zwischen fünf grossen Lücken"). The Acanthodesmida may be derived from the Eucoronida by reduction of the basilar rod of the sagittal ring. If in *Eucoronis* this basal rod be lost, *Coronidium* arises.

1. *Coronidium dyostephanus*, n. sp. (Pl. 82, fig. 7).

Frontal ring elliptical, with few scattered thorns, twice as broad as high, and three times as broad as the smooth rhombic basal ring. Sagittal ring semicircular, very stout, twice as thick as the two other rings, with short lateral thorns (in the figure seen from the apical pole, which exhibits a four-lobed dimple). Basal gate rhombic.

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·16.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

2. *Coronidium diadema*, n. sp. (Pl. 82, fig. 8).

Frontal ring kidney-shaped, one and a half times as broad as high, with a slight sagittal constriction. Sagittal ring ovate, smaller, about of the same size as the elliptical basal ring. Rods of all three rings cylindrical, bearing numerous short and stout curved spines, partly simple, partly branched. Four bunches of larger spines on the four corners of the basal ring, and one very large bunch on the apical pole. Basal gate elliptical, one and a half times as broad as long.

*Dimensions.*—Height of the frontal ring 0·13, breadth 0·18.

*Habitat.*—Indian Ocean (Madagascar), Rabbe, surface.

3. *Coronidium cervicorne*, n. sp. (Pl. 82, fig. 1).

Frontal ring kidney-shaped, twice as broad as high, one and a half times as broad as the elliptical basal ring, both with a slight sagittal constriction. Sagittal ring ovate. All three rings

(in the figure seen from the apical pole) with cylindrical rods, armed with numerous stout spines, branched like a deer's antler. Basal gate rather oblong, twice as broad as long.

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·16.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

4. *Coronidium acacia*, n. sp. (Pl. 82, fig. 2).

Frontal ring and sagittal ring nearly circular, of equal size, truncated at the base. Basal ring circular, somewhat smaller. All three rings with prominent edges, bearing bunches of short and straight pointed spines, like those of an Acacia. Basal gate circular.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·14.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

## Genus 417. *Acanthodesmia*,[1] J. Müller, 1856, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 485.

*Definition.*—Coronida with five large, partly latticed gates (four lateral and one basal). Skeleton composed of two incomplete, partly fenestrated meridional rings, and one complete basal ring.

The genus *Acanthodesmia*, the oldest known form of all Coronida, differs from the preceding *Coronidium*, its ancestral form, in the development of irregular loose lattice-work along the rings, and therefore bears to it the same relation that *Zygostephanium* does to *Zygostephanus*. The first species described by Johannes Müller, *Acanthodesmia vinculata* ("with five large gates between the bars of the shell") remains the true type of this genus; the second species described by him (*Acanthodesmia dumetum*) belongs to the Plectanida (*Polyplecta*).

1. *Acanthodesmia vinculata*, J. Müller.

*Acanthodesmia vinculata*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 30, Taf. i. figs. 4–6 (*non* 7).

*Lithocircus vinculatus*, J. Müller, 1856, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 484.

Frontal ring violin-shaped, one and a half times as broad as high, with a sagittal constriction. Sagittal ring ovate, smaller. The four gates between the two rings are partly fenestrated by a few thin threads, irregularly branched and connecting the two rings. A few short thorns are scattered here and there. Basal gate elliptical.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·18.

*Habitat.*—Mediterranean (Nice), Atlantic (Canary Islands), surface.

[1] *Acanthodesmia* = Thorn-band; ἄκανθα, δέσμιον.

2. *Acanthodesmia ceratospyris*, n. sp.

Frontal ring violin-shaped, one and a half times as broad as high, with a deep sagittal constriction. Sagittal ring semicircular, half as high as the frontal ring. The four gates between the two rings are partly fenestrated by anastomosing branches of the numerous, irregularly branched spines, which cover all three rings. Basal gate nearly circular, smaller than the sagittal ring.

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·12.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Acanthodesmia corona*, n. sp. (Pl. 93, fig. 5).

Frontal ring kidney-shaped, nearly twice as broad as high, with a flat sagittal constriction. Sagittal ring semicircular. The four gates between the two rings are partly fenestrated by an arachnoidal network, composed of thin, irregularly branched threads, arising from the rings. The edges of all three rings are armed with irregular thorns. Basal gate circular, larger than the sagittal ring.

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·14.

*Habitat.*—Indian Ocean (Madagascar), Rabbe, surface.

4. *Acanthodesmia mülleri*, n. sp.

Frontal ring kidney-shaped, with a deep sagittal constriction. Sagittal ring ovate. The four gates between the two rings irregularly fenestrated, with a few large polygonal meshes. Edges of the rings with a few scattered thorns. Basal gate violin-shaped.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·16.

*Habitat.*—Tropical Atlantic, Station 347, surface.

## Subfamily 3. EUCORONIDA, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Coronida with six large gates (four lateral and two basal gates). Skeleton composed of three rings perpendicular to one another, two of which are complete (the vertical sagittal, and the horizontal basal ring); the third is incomplete (the vertical frontal ring).

### Genus 418. *Eucoronis*,[1] Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Coronida with six large simple gates (four lateral and two basal). Skeleton composed of two complete rings (the sagittal and basal) and one incomplete (frontal) ring. Basal ring without typical feet.

[1] *Eucoronis*=Good crown; εὖ, κορωνίς.

The genus *Eucoronis* and the following two nearly allied genera (*Plectocoronis* and *Podocoronis*) compose together the important subfamily Eucoronida. In this typical main group of Coronida the shell is constantly composed of three rings and six gates. The vertical sagittal ring and the horizontal basal ring are complete (as in the Semantida); the vertical frontal ring is incomplete. Between these three rings remain six large open gates, the four upper (or lateral) are always much larger than the four lower (or basal gates). *Eucoronis* may be derived from *Semantis* by development of the frontal ring.

Subgenus 1. *Acrocoronis*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Rings smooth or rough, armed with numerous short spines or thorns.

1. *Eucoronis perspicillum*, n. sp. (Pl. 82, fig. 6).

Frontal ring elliptical, twice as broad as high, with a slight constriction at the apical pole, armed with three pairs of short conical spines, one apical pair (near the constriction) and two lateral pairs (one upper and one lower pair). Sagittal ring of the same height, half the breadth and double the thickness, also armed with three pairs of spines (one basal, one dorsal, and one ventral pair).

*Dimensions.*—Height of the frontal ring 0·11, breadth 0·22.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

2. *Eucoronis lævigata*, n. sp.

Frontal ring elliptical, smooth, one and a half times as broad as high, without sagittal constriction, with horizontal basal gates. Sagittal ring of the same height and thickness, also elliptical and smooth. No spines on either of the smooth rings.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·15.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

3. *Eucoronis nephrospyris*, n. sp. (Pl. 82, fig. 5).

Frontal ring kidney-shaped, in the upper half convex, in the lower concave, with a sagittal constriction (often much deeper than in the specimen figured). Sagittal ring ovate, about two-thirds as high as the frontal ring. Rods of both rings without edges, cylindrical, armed with numerous short conical thorns.

*Dimensions.*—Height of the frontal ring 0·1 to 0·12, breadth 0·15 to 0·18.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, many Stations, surface and at various depths.

4. *Eucoronis angulata*, n. sp. (Pl. 82, fig. 3).

Frontal ring violin-shaped, twice as broad as high, on the upper and the lower margin concave, with a deep sagittal constriction. Sagittal ring pentagonal, with straight horizontal basal rod, two-thirds as high as the frontal ring. Rods of both rings with sharp prominent edges, bearing numerous short pyramidal spines.

*Dimensions.*—Height of the frontal ring 0·09, breadth 0·17.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Subgenus 2. *Lithocoronis*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Rings armed with numerous large, branched or arborescent spines.

5. *Eucoronis cervicornis*, n. sp.

Frontal ring kidney-shaped, in the upper half convex, in the lower concave, with sagittal constriction. Sagittal ring ovate, two-thirds as high as the frontal ring. Both rings armed with numerous stout spines, irregularly branched like a deer's antler. (Very similar to *Coronidium cervicorne*, Pl. 82, fig. 1, which I formerly confounded with it, but differing in the complete sagittal ring, which in the latter form is incomplete and has lost its basal part.)

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·2.

*Habitat.*—Central Pacific, Station 264, surface.

6. *Eucoronis arborescens*, n. sp.

Frontal ring kidney-shaped, with a deep sagittal constriction in the concave basal part. Sagittal ring ovate, half as high as the frontal ring. Both rings armed with numerous thin, richly branched and arborescent spines (branches much thinner and more numerous than in the preceding and following species).

*Dimensions.*—Height of the frontal ring 0·15, breadth 0·25.

*Habitat.*—Equatorial Atlantic, Station 247, surface.

7. *Eucoronis challengeri*, n. sp. (Pl. 82, fig. 4).

*Lithocoronis challengeri*, Haeckel, 1881, Prodromus, p. 445.

Frontal ring violin-shaped, one and a half times as broad as high, with a strong sagittal constriction. Sagittal ring nearly circular, two-thirds as high as the frontal ring. Both rings armed with numerous irregularly branched spines. (The specimen figured, with red central capsule and numerous xanthellæ, was observed living by me at the Canary Islands.)

*Dimensions.*—Height of the frontal ring 0·1 to 0·12, breadth 0·14 to 0·17.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, surface and at various depths.

Genus 419. *Plectocoronis*,[1] Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Coronida with six large, partly latticed gates (four lateral and two basal). Skeleton composed of two complete rings (the sagittal and basal) and one incomplete (frontal) ring. Basal ring without developed typical feet.

The genus *Plectocoronis* differs from the preceding *Eucoronis*, its ancestral form, in the development of loose irregular lattice-work along the two meridional rings, and therefore bears to it the same relation that *Acanthodesmia* does to *Coronidium*. If the lattice-work become more complete and close the gates, these Coronida pass over directly into Spyroidea (Zygospyrida).

1. *Plectocoronis anacantha*, n. sp.

Basal ring and frontal ring elliptical, without sagittal constriction. Sagittal ring ovate. The frontal and sagittal rings are bordered on both edges with an incomplete series of small irregular pores. All three rings smooth, without spines.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·16.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

2. *Plectocoronis triacantha*, n. sp.

Basal ring and frontal ring nearly circular, without sagittal constriction. Sagittal ring elliptical, prolonged at the apex into an apical horn from which two branched lateral bows descend and unite with the uppermost parts of the frontal ring. Four other small bows descend from the lowermost parts of the latter and unite with the basal ring. From the lateral corners of the basal ring descend two short vertical feet. (May be regarded as derived from *Podocoronis toxarium*, Pl. 83, fig. 7, by development of the bows connecting the rings.)

*Dimensions.*—Height of the frontal ring 0·11, breadth 0·13.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Plectocoronis pentacantha*, n. sp. (Pl. 93, fig. 6).

Basal ring and frontal ring kidney-shaped, with deep sagittal constriction. Sagittal ring ovate, prolonged at the apex into an oblique horn. From the edges of the angular rings delicate threads arise, which anastomose and form irregular arachnoidal meshes, partly closing the four open lateral gates. Two basal gates simple. From the four nodal points of the basal ring there arise four, short diverging feet, comparable to rudimentary cortinar feet (two lateral from the frontal ring and two sagittal from the primary ring, as basal prolongations).

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·18.

*Habitat.*—Central Pacific, Station 271, surface.

[1] *Plectocoronis* = Crown with framework; πλεκτός, κορωνίς.

Genus 420. *Podocoronis*,[1] Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Coronida with six large gates (four lateral and two basal). Skeleton composed of two complete rings (the sagittal and basal) and one incomplete (frontal) ring. Basal ring provided with typical, regularly disposed, descending feet (cortinar feet).

The genus *Podocoronis* differs from the two preceding nearly allied genera in the development of typical radial feet on the basal ring, which by their regular disposition and their general appearance among the Spyroidea and Cyrtoidea obtain great morphological importance. According to the different number and disposition of these basal feet (or "cortinar feet"), the following subgenera may be distinguished (regarded in my Prodromus, 1881, p. 445, as separate genera):—*Dipocoronis* with two lateral feet, *Tripocoronis* with three cortinar feet (most important!), *Tetracoronis* with four crossed feet, *Hexacoronis* with six radial feet, *Stylocoronis* with numerous (8 or more feet). These subgenera have important relations to the corresponding genera of Zygospyrida.

Subgenus 1. *Dipocoronis*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Basal ring with two descending lateral feet (right and left) as prolongations of the frontal ring.

1. *Podocoronis dipodiscus*, n. sp.

Basal ring nearly circular, with two conical, straight, parallel descending feet, which are direct lateral prolongations of the subcircular frontal ring, and half as long as it. The ovate sagittal ring bears at the apex a short conical vertical horn. All rings nearly smooth.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·14.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Podocoronis toxarium*, n. sp. (Pl. 83, fig. 7).

Basal ring elliptical, with two descending, slightly curved conical feet, lateral prolongations of the subcircular frontal ring. The ovate sagittal ring bears at the apex a cylindrical vertical horn, which is connected by two descending lateral arches (or galear arches) with the uppermost part of the frontal ring.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·13.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2900 fathoms.

[1] *Podocoronis* = Crown with feet; *πούς, κορωνίς*.

Subgenus 2. *Tripocoronis*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Basal ring with three descending feet (one caudal and two pectoral).

3. *Podocoronis cortiniscus*, n. sp. (Pl. 97, fig. 2).

Basal ring violin-shaped, with three straight divergent thorny feet, about as long as the ovate sagittal ring. The dorsal part of the latter is straight, vertical, and prolonged downwards into the caudal foot, upwards into a stout, thorny, vertical apical horn. The ventral part is semicircular and gives off the lateral branches, forming the kidney-shaped sagittal ring. All the rings and their apophyses are armed with stout thorns. This and the following tripodal species may be directly derived from *Cortina*.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·15.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

4. *Podocoronis tripodiscus*, n. sp.

Basal ring kidney-shaped, with three large divergent curved feet, nearly twice as long as the semicircular sagittal ring. The straight dorsal part of the latter is prolonged downwards into the caudal foot, upwards into a large branched apical horn, curved backwards. Differs from the preceding species mainly in the longer curved apophyses and in the larger violin-shaped frontal ring.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·2.

*Habitat.*—North Pacific, Station 238, surface.

Subgenus 3. *Tetracoronis*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Basal ring with four descending feet (two sagittal and two lateral).

5. *Podocoronis tetrapodiscus*, n. sp.

Basal ring kidney-shaped, with four stout and straight divergent feet, about as long as the sagittal ring; two of them are lateral and arise from the basal corners of the violin-shaped frontal ring (at its junction with the basal ring); two are sagittal, and arise from the basal corners of the semicircular sagittal ring (one posterior caudal and one anterior sternal). The straight dorsal part of the sagittal ring is prolonged upwards into an apical horn. All the rings are thorny.

*Dimensions.*—Height of the frontal ring 0·15, breadth 0·25.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

Subgenus 4. *Hexacoronis*, Haeckel.

*Definition.*—Basal ring with six radial descending feet (two sagittal, two pectoral, and two tergal feet).

6. *Podocoronis hexapodiscus*, n. sp.

Basal ring violin-shaped, with six conical, vertically descending feet, half as long as the sagittal ring; two of them are sagittal (arising from the two basal corners of the sagittal ring, caudal and sternal feet); the other four are lateral, and prolongations of the forked basal parts of the frontal ring, which is inserted on the basal ring with two forked branches; the anterior correspond to the pectoral, the posterior to the tergal feet of *Hexaspyris*. All the rings are thorny.

*Dimensions.*—Height of the frontal ring 0·11, breadth 0·17.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

Subgenus 5. *Stylocoronis*, Haeckel.

*Definition.*—Basal ring with numerous (eight to twelve or more) descending feet.

7. *Podocoronis petalospyris*, n. sp.

Basal ring violin-shaped, with ten to twelve flat lamellar, vertically descending feet, about as long as the ovate sagittal ring. Frontal ring twice as broad as long, elliptical. All rings nearly smooth. Similar to a *Petalospyris* without lattice-work.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·2.

*Habitat.*—Fossil in Barbados.

8. *Podocoronis polypodiscus*, n. sp.

Basal ring elliptical, with fifteen to eighteen conical, curved, descending feet, half as long as the ovate sagittal ring. Frontal ring kidney-shaped, one and a half times as broad as long. All the rings armed with short conical spines.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·18.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

Subfamily 4. TRISSOCYCLIDA, Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Coronida with eight large gates (four superior lateral and four inferior basal). Skeleton composed of three complete rings, perpendicular to one another; two of which are vertical (the primary or sagittal and the secondary or frontal ring), the third is horizontal (the tertiary or basal ring).

Genus 421. *Tristephanium*,[1] Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Coronida with eight large, simple gates of different sizes; the four upper or lateral gates larger than the four lower or basal gates. Skeleton composed of three simple complete rings, perpendicular to one another.

[1] *Tristephanium*=Small crown with three rings; τρίς, στεφάνιον.

The genus *Tristephanium*, and the three following genera derived from it, represent together the interesting subfamily of Trissocyclida (Prodromus, 1881, p. 446). These differ from all other Coronida in the possession of three complete rings, perpendicular to one another. The first of these is the vertical sagittal ring, the second the vertical frontal ring, and the third the horizontal basal ring. Since these three rings lie in the three dimensive planes, they are perpendicular to one another; and between them remain eight large open gates. Originally the four upper or lateral gates (corresponding to those of *Zygostephanus*) are much larger, the four lower or basal gates (corresponding to those of *Semantrum*) much smaller; but afterwards the latter may reach the size of the former, so that the basal ring becomes equatorial (in *Trissocircus* and *Trissocyclus*). The common ancestral form of the Trissocyclida (*Tristephanium*) may be derived directly either from *Semantrum* (by complete development of the frontal ring) or from *Eucoronis* (by complete development of four basal gates).

Subgenus 1. *Triostephus*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Sagittal and frontal ring of different size and form.

1. *Tristephanium dimensivum*, n. sp. (Pl. 93, fig. 9).

Sagittal ring ovate, with a large thorny apical horn, smaller than the two other rings. Frontal ring violin-shaped, with a deep sagittal constriction. Basal ring also violin-shaped, in the sagittal axis constricted. Its four gates (two jugular and two cardinal) of nearly equal size. All three rings angular, armed with scattered, stout, thorny spines, which are larger in the basal half.

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·12.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

2. *Tristephanium octopyle*, n. sp. (Pl. 93, fig. 8).

Sagittal ring ovate, nearly smooth, smaller than the two other rings. Frontal ring kidney-shaped, with a deep basal constriction. Basal ring violin-shaped. The jugular gates about half as large as the cardinal gates. Rods of the rings cylindrical, with few scattered thorns.

*Dimensions.*—Height of the frontal ring 0·09, breadth 0·14.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Tristephanium hertwigii*, Haeckel.

*Acanthodesmia hertwigii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 499, 539, Taf. xxxii. figs. 9*a*–9*c*.

Sagittal ring ovate or nearly semicircular; its dorsal rod straight, smooth (fig. 9*c*, *a*), its ventral rod (*b*) curved, thorny. Frontal ring much larger, thorny, violin-shaped, with a slight sagittal con-

striction. Basal ring smaller than the sagittal ring, thorny, kidney-shaped, with four different gates; the two cardinal pores much larger than the two jugular pores. (The four basal pores are often much larger than in the specimen figured by Bütschli. Also the number, form, and size of the spines is very variable.)

*Dimensions.*—Height of the frontal ring 0·07 to 0·09, breadth 0·17 to 0·2.

*Habitat.*—Fossil in Barbados.

### Subgenus 2. *Tristephaniscus*, Haeckel, 1881, Prodromus, p. 445.

*Definition.*—Sagittal and frontal ring of equal size and form.

#### 4. *Tristephanium quadricorne*, n. sp. (Pl. 93, fig. 7).

Sagittal and frontal ring of equal size and form, larger than the circular basal ring. From the four corners, in which the latter crosses the two former, arise four strong, divergent spines, branched like a deer's antler. Some smaller spines are scattered on the rings, and a bunch of four spines arises on the apical pole. The four upper gates are triangular, the four lower nearly semicircular, the latter of equal size, half as large as the former.

*Dimensions.*—Height of the frontal ring 0·13, breadth 0·14.

*Habitat.*—South Atlantic, Station 342, depth 1445 fathoms.

### Genus 422. *Tricyclidium*,[1] Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Coronida with eight large, partly fenestrated gates; the four upper or lateral gates larger than the four lower or basal gates. Skeleton composed of three latticed complete rings, perpendicular to one another.

The genus *Tricyclidium* differs from the preceding *Tristephanium*, its ancestral form, in the development of loose rudimentary lattice-work along the rings, and therefore bears to it the same relation that *Plectocoronis* does to *Eucoronis*. It may pass directly over into *Dictyospyris*.

#### 1. *Tricyclidium dictyospyris*, n. sp. (Pl. 93, fig. 13).

Sagittal ring ovate, twice as thick as the two other larger rings, which become very thin, thread-like at the lateral junction, and are both slightly violin-shaped, in the middle sagittal plane constricted; the frontal ring larger than the basal. All three rings bear small scattered spines, which are irregularly branched, and by anastomoses of the thread-like branches form small irregular meshes along the rings. The four basal gates are of equal size.

*Dimensions.*—Height of the frontal ring 0·11, breadth 0·15.

*Habitat.*—Equatorial Atlantic, Station 347, depth 2250 fathoms.

[1] *Tricyclidium* = Composed of three small crossed circles; τρίς, κυκλίδιον.

2. *Tricyclidium semantrum*, n. sp.

Sagittal ring ovate, smaller than the violin-shaped frontal ring and larger than the elliptical basal ring. All three rings of nearly equal thickness, armed with short irregular branches, which are partly connected, and forming small irregular meshes along the rings. The four basal gates are of different sizes; the two anterior (jugular) gates only half as large as the two posterior (cardinal) gates.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·18.

*Habitat.*—South Atlantic, Station 348, depth 2450 fathoms.

## Genus 423. *Trissocircus*,[1] Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Coronida with eight large simple gates of equal size. Skeleton composed of three simple complete rings, perpendicular to one another.

The genus *Trissocircus*, and the following nearly allied *Trissocyclus*, differ from the two preceding ancestral genera in the remarkable growth of the four basal gates, which reach the size of the lateral gates. Therefore both hemispheres of the shell (the upper or apical and the lower or basal) here become equal, and the basal ring becomes equatorial. Sometimes even all three rings attain the same size, so that it is difficult or impossible to distinguish them. In this curious case the Coronida exhibit a striking resemblance to some Sphæroidea.

### Subgenus 1. *Tricircarium*, Haeckel.

*Definition.*—Sagittal ring smaller than the two other rings, which are both elliptical.

1. *Trissocircus lentellipsis*, n. sp. (Pl. 93, fig. 10).

All three rings elliptical, of different sizes, smooth, without spines. The sagittal ring is the smallest, but two to three times as thick as the other two rings, which have the larger (transverse) axis common. The smaller (sagittal) axis of the sagittal ring is also the smaller axis of the equatorial ring, whilst the larger (principal) axis of the former is the smaller axis of the frontal ring.

*Dimensions.*—Height of the frontal ring 0·07, breadth 0·1.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

2. *Trissocircus binellipsis*, n. sp. (Pl. 83, fig. 6).

Sagittal ring circular, smaller than the other two rings, which are both equal, elliptical, slightly constricted on the poles of the principal and transverse axes. The axis of the circular sagittal

[1] *Trissocircus* = Composed of three crossed circles; τρισσός, κίρκος.

ring is the shorter axis of the frontal and equatorial ring, and about half as long as their longer axis. All three rings smooth, without spines.

*Dimensions.*—Height of the frontal ring 0·08, breadth 0·12.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Trissocircus octostoma* (Pl. 93, fig. 11).

Sagittal ring circular, smaller than the other two rings, which are both equal, elliptical, distinctly constricted at the poles of the principal and transverse axes. The axis of the circular sagittal ring is the shorter axis of the frontal and equatorial ring, about one-third shorter than their longer axis. All three rings armed with short, irregularly branched spines.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·12.

*Habitat.*—Indian Ocean, Ceylon (Belligemma), Haeckel, surface.

Subgenus 2. *Tricirconium*, Haeckel.

*Definition.*—All three rings equal, circular.

4. *Trissocircus octahedrus*, n. sp.

All three rings equal, circular, smooth, their rods cylindrical (in the transverse section circular). From each pole of the three equal axes arises a short conical spine; these six spines correspond to the six corners of a regular octahedron.

*Dimensions.*—Diameter of all three rings 0·08, thickness 0·006.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

5. *Trissocircus globus*, n. sp. (Pl. 82, fig. 13).

All three rings equal, circular, thorny; their rods prismatic (in the transverse section triangular), with three sharp dentated edges and scattered branched thorns. From each pole of the three equal axes (which correspond to the three axes of a regular octahedron) arises a bunch of larger spines.

*Dimensions.*—Diameter of all three rings 0·12, thickness 0·01.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

Genus 424. *Trissocyclus*,[1] Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Coronida with eight large, partly fenestrated gates of equal size. Skeleton composed of three complete latticed rings, perpendicular to one another.

The genus *Trissocyclus* differs from its nearly allied ancestral form *Trissocircus* only in the development of small anastomosing branches along the edges of the rings. The incomplete lattice-work, produced by these anastomoses, partly protects the eight large gates. The three rings are either of equal or of different sizes.

[1] *Trissocyclus* = Composed of three crossed rings; τρισσός, κύκλος.

### Subgenus 1. *Tricyclarium*, Haeckel.

*Definition.*—Sagittal ring circular, smaller than the other two rings, which are both elliptical.

1. *Trissocyclus stauroporus*, n. sp. (Pl. 83, fig. 5).

Sagittal ring circular, smaller than the other two equal elliptical rings. On each of the six corners (or crossing points of every two rings) are developed four small pores, forming a cross around the poles of the three axes. All three rings smooth, without spines.

*Dimensions.*—Height of the frontal ring 0·09, breadth 0·13.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Trissocyclus triaxonius*, n. sp.

Sagittal ring circular, smaller than the two other equal elliptical rings. From the edges of all three rings are developed small branches, which by irregular ramification and anastomoses form small irregular meshes along the rings. Similar to *Trissocircus octostoma*, but with thicker rings; it may be developed from the latter species by connection of the branches which border the rings.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·15.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

### Subgenus 2. *Tricyclonium*, Haeckel.

*Definition.*—All three rings equal, circular.

3. *Trissocyclus sphæridium*, n. sp. (Pl. 93, fig. 12).

All three rings equal, circular, thorny; their rods prismatic, three-sided, with three denticulate edges; the teeth of the lateral edges become branched, and form by anastomoses of the branches small irregular meshes, which partly protect the eight large open gates.

*Dimensions.*—Diameter of the three rings 0·16, thickness 0·012.

*Habitat.*—Indian Ocean, Belligemma, Ceylon (Haeckel), surface.

## Family LI. TYMPANIDA, Haeckel.

*Parastephida*, Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Stephoidea with two parallel horizontal rings, an upper mitral and a lower basal ring; both connected by complete or incomplete vertical rings, or by parallel vertical columellæ.

The family Tympanida (or Parastephida) differs from the other Stephoidea in the development of two horizontal rings, which lie in horizontal planes and arise from the upper and the lower poles of the primary sagittal ring. Therefore the same formation, which we found in the Semantida on the basal pole only of the main axis, here takes place also on its apical pole. On both poles arise at each side from the sagittal ring two corresponding pairs of curved branches: the lateral ends of the opposite branches (dorsal and ventral branch) become united in the frontal plane and so form two complete horizontal rings. The upper ring, composed of the superior or mitral branches, may be called the mitral ring, the lower ring, formed by the inferior or basal branches, the basal ring. Both rings are commonly of nearly equal size, more rarely of different sizes. Their connection is effected either by the primary (sagittal) ring only, or also by secondary vertical rings, a frontal ring in the lateral plane, or some diagonal meridian rings between the latter and the former. These vertical rings, which connect both horizontal rings in the form of "columellæ," may be either complete or incomplete; in the latter case their apical and basal parts are lost, the dorsal and ventral parts only being preserved.

The Tympanida develop a great variety of different forms, greater than in the three other families of Stephoidea, so that we may distinguish here not less than sixteen genera and seventy-two species. Hitherto only three species were known: *Prismatium tripleurum*, figured in 1862 in my Monograph, *Tympanidium barbadense*, figured by Bury in the "fossil Polycystins of Barbados," and *Tympaniscus fibula*, described in 1875 by Ehrenberg as a *Ceratospyris fibula*. The number of species in this large and richly developed group will be considerably augmented by further researches. A great many of them exhibit remarkable relations to different NASSELLARIA. For better survey of the whole family we distinguish here four subfamilies, the first of which (Protympanida) is probably the common ancestral group of the other three. They may have been derived originally either from the Semantida or directly from the Stephanida.

The first subfamily, Protympanida, exhibits a complete primary or vertical sagittal ring, bearing on the upper part a horizontal mitral ring, on the lower part a horizontal basal ring. Therefore the gates of these two parallel rings become bisected by the sagittal ring, each divided into a right and a left half. The sagittal ring itself becomes divided by the two horizontal rings into four parts or rods; two opposite of these are more or less vertical; the dorsal (posterior) and the ventral (anterior) rod; the two other rods are more or less horizontal; the mitral (upper) and the basal (lower) rod.

In *Protympanium* (Pl. 93, fig. 14), the simplest and most primitive form of Tympanida, the connection of the two horizontal rings is effected only by the dorsal and ventral rods of the sagittal ring forming two parallel more or less vertical "columellæ." In all other Protympanida accessory columellæ are developed between the latter. In the greater number we find two secondary columellæ in the lateral plane, being the lateral

segments of an incomplete frontal ring (*Acrocubus*, Pl. 93, figs. 15–17). Between the latter and the former there are sometimes developed four tertiary columellæ, as segments of two crossed incomplete diagonal rings (*Tympanidium*, Pl. 94, figs. 1, 18). At other times we find six columellæ; here probably the frontal ring is cleft into halves on each side (*Tympaniscus*, Pl. 94, figs. 4–7). Some genera are distinguished by the development of an equatorial ring, or a third horizontal ring (between the upper mitral and the lower basal ring); this equatorial ring is either complete (*Microcubus*, Pl. 94, figs. 8–10) or incomplete, developed only laterally (*Octotympanum*, Pl. 94, figs. 2, 3). The genus *Toxarium* (Pl. 93, figs. 18–20) is distinguished by the development of accessory pairs of bows in the frontal plane, upper or galear bows and lower or thoracal bows, remarkable as beginnings of the accessory joints, which we distinguish in many Spyroidea and Cyrtoidea as "galea and thorax."

The second subfamily of Tympanida are the Paratympanida, in which the two horizontal rings become closed by lattice-work. The numerous columellæ connecting the two rings are here either divergent (*Paratympanum*, with two unequal rings, Pl. 94, fig. 14) or parallel and vertical (*Lithotympanum*, with two equal rings, Pl. 83, fig. 1). The shell of the latter assumes the form of a drum.

A third small subfamily, Dystympanida, is represented by a single genus only, *Dystympanium* (Pl. 94, figs. 15, 16). Here only the upper or mitral ring is closed by lattice-work, whilst the lower or basal ring exhibits a quite simple opening, a large "basal gate" which has probably arisen by loss of the basilar rod of the sagittal ring. These curious forms exhibit a remarkable resemblance to some Monocyrtida, and also to the *Dictyocha* (Phæodaria).

The fourth subfamily, the Eutympanida, are distinguished by the simple wide aperture of the two horizontal rings; the upper enclosing a simple "mitral gate," the lower a simple "basal gate." Here probably the two horizontal parts of the sagittal ring (the upper mitral rod and the lower basilar rod) are lost by reduction; its two vertical parts (the dorsal and ventral rods) only remaining and forming the two parallel columellæ, which connect the two horizontal rings (*Parastephanus*, Pl. 93, fig. 21). In this group also secondary columellæ are commonly developed between the two rings, alternating with the two primary columellæ. *Pseudocubus* (Pl. 94, figs. 11, 12), resembling an obelisk, exhibits four divergent columellæ; the two sagittal of these are probably the vertical parts of the primary ring, whilst the two lateral are the halves of an incomplete frontal ring. In *Lithocubus* (Pl. 82, fig. 12) the four columellæ are parallel and vertical, the two rings being equal; the shell here assumes the form of a geometrical cube. *Prismatium* is distinguished by three parallel columellæ; two of these are probably parts of a frontal ring, whilst the third is the remains of a reduced sagittal ring. In *Circotympanum* (Pl. 94, fig. 17) and in *Lithotympanum* (Pl. 82, fig. 11) the number of the columellæ is augmented, there being six to eight or more; in the former they are divergent

(the two rings being of different sizes), in the latter parallel (the two rings being equal); the fundamental form of the former is a truncated pyramid, of the latter a prism.

Comparing these differences between the four subfamilies of Tympanida, we may suppose that the common ancestral group are the Protympanida, derived from the Semantida by the formation of a mitral ring. If the two horizontal rings become closed by lattice-work, the Paratympanida arise. When the mitral ring only becomes latticed, the basal ring being simple, the Dystympanida originate. Finally, the fourth subfamily, the Eutympanida, may be derived from the Protympanida by the loss of the two horizontal parts of the sagittal ring.

The two horizontal rings (upper mitral and lower basal) and the two vertical rings (primary sagittal and secondary frontal), which thus compose the loose framework of the Tympanida, are rarely smooth, commonly armed with spines or branches, similar to those of the Coronida. The rods or bars are either roundish (with circular transverse section) or angular (commonly with triangular transverse section). The paired branches of the two vertical rings often preserve the characteristic arrangement inherited from the Semantida and Stephanida. The two horizontal rings sometimes exhibit typical apophyses, which recur in the Spyroidea and Cyrtoidea. The mitral ring may possess one odd apical horn and two paired frontal horns (Pl. 93, figs. 16, 17, 19, 23). The basal ring sometimes bears the three typical feet of *Cortina* (Pl. 93, figs. 16, 22), one odd caudal foot and two paired pectoral feet. Sometimes a fourth (sternal) foot is developed (Pl. 94, fig. 4), at other times only two lateral feet (Pl. 94, figs. 5, 6).

*Synopsis of the Genera of Tympanida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Protympanida. Two horizontal rings (upper mitral ring and lower basal ring) bisected by the complete sagittal ring. | Two horizontal rings connected by two columellæ. | | One complete sagittal ring (no frontal ring), | 425. *Protympanium.* |
| | Two horizontal rings connected by four columellæ (the halves of the sagittal and the frontal ring). | No equatorial ring. | No galear and thoracal bows, | 426. *Acrocubus.* |
| | | | Galear and thoracal bows, | 427. *Toxarium.* |
| | | An equatorial ring. | Equatorial ring complete, | 428. *Microcubus.* |
| | | | Equatorial ring incomplete, | 429. *Octotympanum.* |
| | Two horizontal rings connected by six or eight columellæ (three or four vertical rings). | | Six columellæ (three meridional rings), | 430. *Tympaniscus.* |
| | | | Eight columellæ (four meridional rings), | 431. *Tympanidium.* |
| II. Subfamily Paratympanida. Two horizontal rings fenestrated. | Two horizontal rings closed by a lattice-plate, connected by numerous columellæ. | | Two rings unequal (columellæ divergent), | 432. *Paratympanum.* |
| | | | Two rings equal (columellæ parallel), | 433. *Lithotympanum.* |

| | | | |
|---|---|---|---|
| III. Subfamily Dystympanida. Mitral ring fenestrated, basal ring simple. | Two horizontal rings connected by numerous (six to eight or more columellæ). | Mitral ring closed by a lattice-plate, basal ring simple, . . . | 434. *Dystympanium.* |
| IV. Subfamily Eutympanida. Two horizontal rings (upper mitral ring and lower basal ring) simple. Apical and basal parts of the sagittal ring lost. | Two horizontal rings connected by two or three columellæ (four or five open gates). | Two columellæ (parts of the sagittal ring), . . | 435. *Parastephanus.* |
| | | Three columellæ (parts of the half sagittal and the frontal ring), . . | 436. *Prismatium.* |
| | Two horizontal rings connected by four or more columellæ (six or eight or more open gates). | Four columellæ. Two rings unequal, | 437. *Pseudocubus.* |
| | | Four columellæ. Two rings equal, . | 438. *Lithocubus.* |
| | | Six to eight or more columellæ. Two rings unequal, | 439. *Circotympanum.* |
| | | Six to eight or more columellæ. Two rings equal, . | 440. *Eutympanium.* |

## Subfamily 1. PROTYMPANIDA, Haeckel.

*Definition.*—Tympanida with two bisected horizontal rings, connected by the complete vertical sagittal ring. (The upper mitral ring and the lower basal ring become divided by the complete primary or sagittal ring into two horizontal symmetrical gates, two mitral gates on the apical and two basal gates on the basal pole.)

### Genus 425. *Protympanium*,[1] Haeckel, 1881, Prodromus, p. 447 (*sensu emend.*).

*Definition.*—Tympanida with two bisected horizontal rings, connected by two vertical columellæ.

The genus *Protympanium* is the most simple form of all Tympanida, and probably the common ancestral form of this family. It arises from *Lithocircus* by the development of two horizontal rings, perpendicular to the primary sagittal ring. The upper or mitral ring arises by lateral union of two pairs of superior branches, the lower or basal ring by union of two pairs of basal branches of the primary vertical ring.

1. *Protympanium primordiale*, n. sp.

Mitral and apical ring of equal size, elliptical, smooth, somewhat smaller than the connecting thorny sagittal ring.

*Dimensions.*—Diameter of the two horizontal rings 0·12, of the sagittal ring 0·15.

*Habitat.*—Central Pacific, Stations 263 to 274, at various depths.

[1] *Protympanium*=Primordial drum; πρωτυμπάνιον.

2. *Protympanium amphipodium*, n. sp. (Pl. 93, fig. 14).

Mitral and apical rings of equal size, thin, elliptical, smooth, larger than the broad connecting sagittal ring. The latter bears on the apical and on the basal pole two divergent straight spines (lying in the frontal plane), the two apical (or horns) somewhat smaller and not so spiny as the two basal spines (or feet). In the frontal plane there arise from the two horizontal rings on each side two small opposite spines (remnants or beginnings of the lateral frontal ring ?).

*Dimensions.*—Diameter of the two horizontal rings 0·11, of the sagittal ring 0·07.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Protympanium trissocircus*, n. sp.

Mitral ring smaller than the basal ring; both rings circular, rough. Sagittal ring in size between the two former. All three rings covered with very small thorns.

*Dimensions.*—Diameter of the mitral ring 0·08, of the sagittal ring 0·1, of the basal ring 0·12.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Genus 426. *Acrocubus*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two bisected horizontal rings, connected by four vertical columellæ. No equatorial ring.

The genus *Acrocubus* is the most primitive of those remarkable Tympanida, the skeleton of which represents more or less exactly the form of a geometrical cube. A simple complete sagittal ring bears on the superior and on the inferior part two opposite pairs of lateral branches; by union of the convergent branches of each side there arise two horizontal parallel quadrangular rings, which are bisected by the sagittal ring. Therefore the superior ring encloses two triangular mitral gates, the inferior two triangular basal gates. The lateral corners of the two gates of each side are connected by a vertical rod or columella. These two parallel columellæ are the remaining middle parts of the secondary or frontal ring, which is incomplete on the superior and on the inferior face of the body. If the sagittal ring also become incomplete, by the loss of the superior and inferior part (the anterior and posterior only remaining), then *Acrocubus* is transformed into *Lithocubus*.

### Subgenus 1. *Apocubus*, Haeckel.

*Definition.*—Basal ring without descending feet.

[1] *Acrocubus* = Perfect cube; ἄκρος, κῦβος.

1. *Acrocubus octopylus*, n. sp. (Pl. 82, fig. 9).

Mitral ring somewhat smaller than the basal ring; both rings rhombic, with curved outlines. Sagittal ring elliptical, with six pairs of nodulate protuberances. Four columellæ curved. Nodal points without radial spines.

*Dimensions.*—Height of the frontal ring 0·12, breadth 0·18.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Acrocubus tesseralis*, n. sp.

Mitral ring of the same size as the basal ring; both rings square, smooth, with straight outlines. Sagittal ring also square, smooth. Four columellæ straight. Nodal points without radial spines. The shell has the form of a regular geometrical cube, the edges of which are represented by the rings.

*Dimensions.*—Height of the frontal ring 0·1, breadth 0·11.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

## Subgenus 2. *Dipocubus*, Haeckel.

*Definition.*—Basal ring with two descending feet.

3. *Acrocubus brachiatus*, n. sp.

Mitral ring smaller than the basal, both rings square, with thick straight rods. Sagittal ring tuberculate, square, equatorial part thinner. Four columellæ curved, the two lateral ones prolonged downwards into two vertical parallel straight feet of half their length.

*Dimensions.*—Diameter of the cube 0·12; length of the feet 0·06.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

4. *Acrocubus amphistylus*, n. sp.

Mitral and basal rings of nearly equal size, square, with thick curved rods. Sagittal ring elliptical, in the equatorial part thinner. Frontal ring tuberculate. Four columellæ curved, the two lateral ones prolonged downwards into two vertical, tuberculate feet of half their length.

*Dimensions.*—Diameter of the cube 0·13; length of the feet 0·07.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

5. *Acrocubus arcuatus*, n. sp. (Pl. 93, fig. 15).

Mitral and basal rings, as well as the sagittal ring, of the same form as in the preceding nearly allied species. The two lateral columellæ are prolonged not only downwards into two short

vertical feet, but also upwards into two curved bows, which are united in a vertical ascending horn, arising from the apical pole of the sagittal ring.

*Dimensions.*—Diameter of the cube 0·14; total height 0·21.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### Subgenus 3. *Tripocubus*, Haeckel.

*Definition.*—Basal ring with three descending feet (one odd caudal and two paired lateral).

#### 6. *Acrocubus lasanum*, n. sp.

Mitral ring smaller than the basal; both rings square, with curved rods. Sagittal ring ovate, prolonged upwards into an occipital simple horn, downwards into a caudal foot. Two lateral columellæ prolonged downwards into two pectoral feet. All three feet conical, about as long as the height of the cube.

*Dimensions.*—Diameter of the cube 0·08; length of the feet 0·07.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

#### 7. *Acrocubus cortina*, n. sp. (Pl. 93, fig. 16).

Mitral ring smaller than the basal, both rings elliptical, with curved rods. Sagittal ring ovate, prolonged upwards into an occipital horn, downwards into a caudal foot, as in the preceding species. As in the latter, also, the two lateral columellæ are prolonged downwards into two pectoral feet, but also upwards into two convergent horns, which are united with the occipital horn (commencing the formation of a galea). Rings and feet somewhat thorny.

*Dimensions.*—Diameter of the cube 0·16; total height 0·2.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### Subgenus 4. *Tetracubus*, Haeckel.

*Definition.*—Basal ring with four descending feet (two sagittal and two lateral).

#### 8. *Acrocubus tetrapodius*, n. sp.

Mitral and basal rings of the same size, square, with straight rods, sagittal ring also square. The four vertical columellæ are nearly parallel and straight, prolonged upwards into four short conical horns, downwards into four longer conical feet. (The shell has nearly the form of a geometrical cube, the eight corners of which are prolonged into eight vertical conical spines, four smaller ascending and four larger descending.)

*Dimensions.*—Diameter of the cube 0·09; length of the feet 0·06.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

9. *Acrocubus amphithectus*, n. sp. (Pl. 93, fig. 17).

Mitral ring smaller than the basal, both rings elliptical, with curved rods. Four columellæ thorny, also curved, divergent downwards, prolonged upwards into four thorny convergent horns, downwards into four larger branched divergent feet. The two sagittal horns and feet (anterior and posterior) are smaller than the two lateral (right and left); therefore the fundamental form of this species is distinctly amphithect (as in the *Ctenophora*).

*Dimensions.*—Breadth of the cube 0·12; total height 0·2.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

## Genus 427. *Toxarium*,[1] n. gen.

*Definition.*—Tympanida with two bisected horizontal rings, connected by four vertical columellæ. In the frontal plane two galear bows project upwards, and two thoracal bows downwards.

The genus *Toxarium* differs from its ancestral form *Acrocubus* in the development of two pairs of peculiar bows, placed in the lateral or frontal plane; the upper pair projects above the mitral gates, and may be called the "galear bows," the lower pair projects below the basal gates of the cubical shell, and may be called the "thoracal bows." Both pairs are produced originally by the development of two forked vertical spines, arising in the frontal plane on both poles of the principal axis from the sagittal ring (compare *Protympanium amphipodium*, Pl. 93, fig. 14). The apical fork-branches become connected with the lateral corners of the mitral gates, the basal branches with those of the basal gates. By development of lattice-work between the bows and the rings some Spyroidea (*Amphispyris*, &c.) may have arisen. The important genus *Toxarium* may be divided into three subgenera. In *Toxellium* all the bows are simple, in *Toxonium* all are forked; in *Toxidium* the galear bows are simple, the thoracal bows forked.

### Subgenus 1. *Toxellium*, Haeckel.

*Definition.*—Galear and thoracal bows simple.

1. *Toxarium circospyris*, n. sp. (Pl. 88, fig. 1).

Galear and thoracal bows simple, of about the same size as the frontal bows between them; all bows armed with scattered simple conical spines. Sagittal constriction deep, half as long as the whole shell. Lateral outlines of the shell nearly parallel.

*Dimensions.*—Length of the shell 0·16, breadth 0·13.

*Habitat.*—Central Pacific, Stations 265 to 274, depth 2350 to 2925 fathoms.

[1] *Toxarium*=Small bow; τοξάριον.

2. *Toxarium subcirculare*, n. sp.

Galear and thoracal bows simple, armed with scattered simple spines, of about equal size, smaller than the smooth frontal bows between them. Sagittal constriction very flat. Therefore the frontal perimeter of the shell is nearly circular.

*Dimensions.*—Length of the shell 0·15, breadth 0·14.

*Habitat.*—North Atlantic (Antilles), Weber, surface.

3. *Toxarium thorax*, n. sp. (Pl. 93, fig. 18).

Galear bows simple, smaller than the frontal bows, and these again smaller than the simple thoracal bows; therefore the shell increases in breadth towards the base, and resembles the skeleton of the thorax of one of the higher vertebrates (the bow-pairs corresponding to rib-pairs, the ventral part of the sagittal ring to the sternum, the dorsal part to the vertebral column). Sagittal constriction very deep. All bows are armed with scattered, irregularly branched spines.

*Dimensions.*—Length of the shell 0·17, breadth 0·2.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

4. *Toxarium constrictum*, n. sp.

Galear and thoracal bows simple, of nearly equal size, larger than the frontal bows between them. Therefore the shell is constricted in the equatorial plane. Sagittal constriction also deep. All bows armed with scattered, irregularly branched spines.

*Dimensions.*—Length of the shell 0·14, breadth 0·12.

*Habitat.*—North Pacific, Station 236, surface.

Subgenus 2. *Toxidium*, Haeckel.

*Definition.*—Galear bows simple, thoracal bows forked.

5. *Toxarium cordatum*, n. sp. (Pl. 93, fig. 19).

Galear bows simple, thoracal bows forked, both somewhat smaller than frontal bows; all bows armed with scattered simple conical spines, mostly developed at the thoracal bows. Both galear bows are united in a central vertical columella, which arises from the apex of the sagittal ring, and is prolonged into an apical horn. Therefore the sagittal constriction exists only in the basal half of the inversely cordate shell.

*Dimensions.*—Length of the shell 0·18, breadth 0·16.

*Habitat.*—South Atlantic, Station 348, depth 2450 fathoms.

6. *Toxarium furcatum*, n. sp.

Galear bows simple, thoracal bows forked, both somewhat broader than the frontal bows. Shell therefore slightly constricted in the equatorial plane. Sagittal constriction rather deep, equal in the apical and basal parts. All bows armed with scattered spines, which are partly simple, partly forked.

*Dimensions.*—Length of the shell 0·14, breadth 0·16.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

7. *Toxarium pedatum*, n. sp.

Galear bows simple, smaller than the frontal bows, which are again smaller than the thoracal bows. Therefore the breadth of the shell increases towards the base. Sagittal constriction flat in the apical part, deep in the basal part. All bows armed with small irregularly scattered spines; at the base six larger divergent feet (two lateral, two anterior, and two posterior).

*Dimensions.*—Length of the shell 0·17, breadth 0·15.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

Subgenus 3. *Toxonium*, Haeckel.

*Definition.*—Galear and thoracal bows forked.

8. *Toxarium costatum*, n. sp.

Galear and thoracal bows forked, smaller than the frontal bows, all bows thorny, without larger spines. Sagittal constriction on both poles deep. Lateral outlines of the shell nearly parallel.

*Dimensions.*—Length of the shell 0·15, breadth 0·12.

*Habitat.*—Indian Ocean, Socotra (Haeckel), surface.

9. *Toxarium bifurcum*, n. sp. (Pl. 93, fig. 20).

Galear and thoracal bows forked, the former smaller than the frontal bows, the latter larger. Sagittal constriction rather flat on the apical pole, which bears a vertical forked horn, very deep on the basal pole of the primary ring. All bows armed with numerous spines, which are partly simple, partly forked, and mainly developed at the basal part of the thoracal bows.

*Dimensions.*—Length of the shell 0·2, breadth 0·2.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 428. *Microcubus*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two bisected horizontal rings, connected by four vertical columellæ, which are bisected again by an equatorial ring.

[1] *Microcubus* = Small cube; μικρός, κῦβος.

The genus *Microcubus* is derived from its ancestral form *Acrocubus* by development of a third horizontal ring, which lies in the equatorial plane, parallel to the upper mitral and the lower basal ring. Whilst these latter are both bisected by the complete vertical sagittal ring, the equatorial ring is complete, and connected at the poles of the sagittal axis with the principal ring, and at the poles of the transverse axis with the frontal ring. Therefore the shell exhibits not eight large gates as in *Acrocubus*, but twelve, viz., four horizontal gates (two superior mitral and two inferior basal), four upper vertical gates (between the mitral and the equatorial ring), and four lower vertical gates (between the basal and the equatorial ring).

1. *Microcubus dodecastoma*, n. sp. (Pl. 94, fig. 9).

All twelve gates simple, irregularly ovate or pentagonal. Frontal ring on the sides concave, constricted by the equatorial ring. All rings curved, armed with short irregular thorns. No larger basal spines.

*Dimensions.*—Length of the shell 0·13, breadth 0·15.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

2. *Microcubus pentacircus*, n. sp.

All twelve gates simple. Frontal ring on the sides convex, not constricted by the equatorial ring. All rings tuberculate, with irregular roundish knots. No larger basal spines. Similar to the preceding species; but the five rings are much thicker and tuberculate (not thorny); the twelve gates are therefore relatively smaller.

*Dimensions.*—Length of the shell 0·1, breadth 0·12.

*Habitat.*—Fossil in Barbados.

3. *Microcubus zonarius*, n. sp. (Pl. 94, fig. 8).

All twelve gates simple, ovate. Frontal ring on the sides convex, not constricted by the equatorial ring, nearly twice as broad as long. All rings thorny, very thin, except only the broad angular sagittal ring. No larger basal spines.

*Dimensions.*—Length of the shell 0·08, breadth 0·15.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Microcubus quadrupes*, n. sp.

All twelve gates simple, square. Frontal ring square, not constricted by the equatorial ring. All rings smooth, quadrangular. Basal ring with four short vertical conical feet, two of which (right and left) are inferior prolongations of the frontal ring, and arise from the lateral corners of the

basal gates; two others are prolongations of the sagittal ring (sternal and caudal), and arise from the medial corners of the basal gates. (The shell is like a small cube with four feet.)

*Dimensions.*—Length of the shell 0·13, breadth 0·11.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

5. *Microcubus cornutus*, n. sp.

Eight gates (two mitral, two basal, and four superior) simple; four inferior gates fenestrated by arachnoidal irregular threads. Frontal ring square, constricted on the sides by the equatorial ring. Basal ring with four short conical vertical feet, as in the preceding species. Sagittal ring with a vertical horn on the apex. All rings with small scattered thorns.

*Dimensions.*—Length of the shell 0·11, breadth 0·13.

*Habitat.*—North Pacific, Station 235, surface.

6. *Microcubus amphispyris*, n. sp. (Pl. 94, fig. 10).

Four gates (two mitral and two basal) simple; eight lateral gates (four superior and four inferior) fenestrated by arachnoidal irregular threads. Frontal ring convex, not constricted by the equatorial ring. Basal ring with six short conical divergent feet (two sagittal and four lateral). Sagittal ring with an apical horn. (Resembles some Spyroidea.)

*Dimensions.*—Length of the shell 0·08, breadth 0·12.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 429. *Octotympanum*,[1] n. gen.

*Definition.*—Tympanida with two bisected horizontal rings converging laterally and connected in the lateral poles of the equatorial plane. Eight large gates.

The genus *Octotympanum* differs from all other Tympanida in the peculiar connection of the two horizontal rings, which here reach the maximum of their growth, converge towards the equator, and come into direct contact on the poles of the equatorial transverse axis. Therefore the shell appears to be composed of three complete vertical meridian rings, the middle of which (the sagittal ring) is free and simple; the two other (subfrontal) rings are grown together at the lateral poles of the equatorial plane; commonly at these poles there arises (on the right and left) a strong lateral spine, and the base of this (or the crossing point of the two touching horizontal rings) corresponds to the remnants of the shortened frontal ring. The crown-shaped shell exhibits therefore eight large gates; two superior (mitral) and two inferior basal gates, two larger anterior (facial) and two larger posterior (occipital) gates. Seen from the lateral poles

[1] *Octotympanum* = Drum with eight gates; ὀκτώ, τύμπανον.

only two of the former are visible, and represent the figure of a vertical 8; seen from the sagittal poles, only two of the latter are visible, in the form of a larger horizontal $\infty$. *Octotympanum* may be derived from *Acrocubus* by reduction of the lateral frontal ring to a knot (or cross-point), and by maximal extension of the two parallel horizontal rings, which become curved downwards laterally and touch at the lateral poles.

1. *Octotympanum octospinum*, n. sp.

Mitral gates smaller than the basal gates; upper halves of the two lateral meridional rings smaller than the lower halves. Rings with few scattered thorns; four larger simple spines, nearly horizontal in the equatorial plane; two on the poles of the sagittal axis, two on the poles of the lateral axis. Four other large spines, nearly vertical at the four lowermost basal points of the subfrontal rings.

*Dimensions.*—Length of the shell 0·09, breadth 0·12.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

2. *Octotympanum octonarium*, n. sp. (Pl. 94, fig. 3).

Mitral gates of the same size as the basal gates; upper and lower halves of the meridional rings of equal size. Rings armed with numerous stout, thorny, simple and forked spines; four very large branched spines in the equatorial plane, nearly horizontal, two on the poles of the sagittal, two on the poles of the transverse axis, the latter curved downwards.

*Dimensions.*—Length of the shell 0·1, breadth 0·2.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Octotympanum arborescens*, n. sp.

Mitral gates smaller than the basal gates, the lower halves of the lateral rings being broader than the upper halves. Rings very spiny, armed with numerous branched spines; ten very large arborescent spines on the lateral rings; two on the poles of the transverse axis, eight on the prominent corners of the diagonal axes (four upper and four lower); sagittal ring thorny.

*Dimensions.*—Length of the shell 0·8, breadth 0·16.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

4. *Octotympanum cervicorne*, n. sp. (Pl. 94, fig. 2).

Mitral and basal gates of equal size, the lower and upper halves of the two crossed lateral rings being nearly equal. Rings armed with numerous branched spines; two very large spines, similar to the antlers of a deer, on the poles of the lateral axis; their branches about half as large as the whole shell. Sagittal ring nearly smooth, with few small thorns on the poles of the main axis.

*Dimensions.*—Length of the shell 0·16, breadth 0·2.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms

## Genus 430. *Tympaniscus*,[1] n. gen.

*Definition.*—Tympanida with two bisected horizontal rings, which are connected by three vertical meridional rings (or six columellæ).

The genus *Tympaniscus* and the following *Tympanidium* differ from all preceding Tympanida in the multiplication of the vertical columellæ, which connect the two horizontal bisected rings. *Tympaniscus* exhibits six columellæ, which may be regarded as halves of three meridional rings. Only one, however, of these is complete (the sagittal ring, which bisects the mitral and the basal ring); the two other meridional rings (placed in diagonal planes) may be regarded as produced by lateral bifurcation of an incomplete frontal ring; this appears to be already foreshadowed in the preceding *Octotympanum*.

### 1. *Tympaniscus corona*, n. sp.

Basal ring larger than the mitral ring, with numerous irregular short spines but without descending feet. Six columellæ strongly curved, in the lower half thicker and thorny; the four lateral much thinner than the two sagittal. Apex of the jointed sagittal ring with a conical horn.

*Dimensions.*—Length of the shell 0·08, breadth 0·11.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 2. *Tympaniscus bipes*, n. sp.

Basal ring of about the same size as the mitral ring, with two lateral descending feet, which are parallel and vertical, simple, without spur, half as long as the sagittal ring. The latter is ovate, twice as long and broad as the two circular frontal rings.

*Dimensions.*—Breadth of the shell 0·14, length 0·09.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 3. *Tympaniscus dipodiscus*, n. sp. (Pl. 94, figs. 5, 6).

Basal ring smaller than the mitral ring, with two lateral descending feet, which are nearly parallel and vertical, obtuse, about as long as the sagittal ring, and which bear on the outside a horizontal spur. Sagittal ring hexagonal, very stout, with a caudal appendix at the base, and with a small sagittal arch, bearing a stout spinulate double knob at the apex. The two subfrontal rings depressed, twice as broad as high, on the outside thorny, connected at each side in the lower half by a double transverse arch.

*Dimensions.*—Breadth of the shell 0·18, length 0·08 (with spines 0·18).

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

[1] *Tympaniscus* = Little drum; τυμπανίσκος.

4. *Tympaniscus tripodiscus*, n. sp. (Pl. 94, fig. 7).

Basal ring of about the same size as the mitral ring, with three large and stout divergent feet (two lateral and one caudal). Sagittal ring stout, broader than the two spiny subsagittal rings; the upper part of the latter bears two ascending arches, which are united with the large apical horn arising from the apex of the sagittal ring. Six columellæ nearly vertical, slightly curved on the outside; their lateral edges armed with numerous simple or forked spines.

*Dimensions.*—Breadth of the shell 0·1, total length 0·12.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

5. *Tympaniscus quadrupes*, n. sp. (Pl. 94, fig. 4).

Basal ring larger than the mitral ring, with four short vertical three-sided pyramidal feet of equal size (two lateral and two sagittal); the feet are three-sided pyramidal, with finely denticulate median edges, and bear at the base a horizontal thorny spur. Sagittal ring at the apex with a very large cross-shaped horn, bearing two horizontal thorny lateral branches; the horn is supported by an anterior and a posterior arch. Six columellæ strongly curved and dentate.

*Dimensions.*—Breadth of the shell 0·15, length 0·12.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

6. *Tympaniscus fibula*, Haeckel.

*Ceratospyris fibula*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 3.

Basal ring of about the same size as the mitral ring, with six large conical descending feet; these are prolongations of the six columellæ, nearly of the same length, slightly divergent, and bear at the base a strong horizontal spur. The six columellæ are strongly curved, spiny, and bear above small arches, which are united with the apical horn of the sagittal ring.

*Dimensions.*—Breadth of the shell 0·09, height 0·05; total height 0·09.

*Habitat.*—Fossil in Barbados.

7. *Tympaniscus dodecaster*, n. sp.

Basal ring of the same size as the mitral ring, with six very large and six alternating smaller, slightly divergent, curved feet, about as long as the shell; the larger are the basal prolongations of the six curved, thorny columellæ. Mitral ring spiny, not overgrown with arches, as in the similar preceding species.

*Dimensions.*—Length of the shell 0·08, breadth 0·12.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

Genus 431. *Tympanidium*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two bisected horizontal rings, which are connected by four vertical meridional rings (or eight columellæ).

The genus *Tympanidium* differs from all other Protympanida in the development of four vertical rings, placed in four different meridional planes. Only one of these is complete, the primary sagittal ring; the three others are incomplete, inserted on the two horizontal rings, which are formed by the paired mitral and basal branches of the sagittal ring; one of these three lies in the frontal plane, the two others in diagonal meridional planes (between the frontal and sagittal). The shell therefore exhibits twelve large gates, four of which are horizontal (the two superior mitral and the two inferior basal gates); the eight others are vertical, separated by the eight columellæ, or the halves of the four meridional rings. In the subgenus *Tympanomma* the number of gates amounts to sixteen, the four lateral gates being bisected by an incomplete equatorial ring. The genus *Tympanidium* may be derived from *Acrocubus* by development of the two diagonal rings (between the frontal and sagittal).

Subgenus 1. *Tympanura*, Haeckel.

*Definition.*—Shell with twelve gates; the four lateral gates simple.

1. *Tympanidium foliosum*, n. sp. (Pl. 94, fig. 1).

Shell with twelve gates; the four lateral gates simple. Basal gates of the shell larger than the mitral gates. Sagittal ring ovate, much smaller than the three other meridional rings, which are armed with numerous large elegant spines, bearing a lanceolate leaf on a thin pedicle. The sagittal ring bears a bunch of similar spines only at the apex, and on both poles of the sagittal axis (in the equator) a single forked spine, with two thorny branches.

*Dimensions.*—Length of the shell 0·09 (with spines 0·25), breadth 0·15.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

2. *Tympanidium spinosum*, n. sp.

Shell with twelve gates; the four lateral gates simple. Basal and mitral gates of about equal size. Shell similar to that of the preceding species, differing mainly in the different armature; the numerous spines, covering the convex outside of the four vertical rings, are not leaf-shaped, but conical, short, of very variable size, partly simple, partly irregularly branched.

*Dimensions.*—Length of the shell 0·08 (with spines 0·2), breadth 0·12.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

[1] *Tympanidium* = Small drum; τυμπανίδιον.

Subgenus 2. *Tympanomma*, Haeckel.

*Definition.*—Shell with sixteen gates (eight median gates, paired on both sides of the sagittal ring, and eight lateral gates, paired on both sides of the frontal ring). The four lateral gates of the two preceding species (subgenus *Tympanura*) are bisected in *Tympanomma* by the lateral parts of an incomplete equatorial ring.

3. *Tympanidium binoctonum*, n. sp. (Pl. 94, fig. 18).

Shell with sixteen gates; the four lateral gates double, bisected by the lateral parts of an incomplete equatorial ring. Basal gates nearly rectangular, of the same breadth as the pentagonal mitral gates, but twice as long. Equatorial outline of the shell (seen in fig. 18 from the apical pole) octagonal. All rods of the shell thin, smooth.

*Dimensions.*—Transverse axis of the shell 0·1, sagittal axis 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

4. *Tympanidium barbadense*, Haeckel.

"Hollow cylinder," &c., Bury, 1862, Polycystins of Barbados, pl. xvi. fig. 1.

Shell with sixteen gates; the four lateral gates double, bisected by an incomplete equatorial ring. Basal gates kidney-shaped, of the same breadth as the circular mitral gates, but twice as long. Equatorial outline of the shell elliptical. All rods of the shell thin, smooth.

*Dimensions.*—Transverse axis of the shell 0·12, sagittal axis 0·08.

*Habitat.*—Fossil in South Naparima, Trinidad, Barbados.

5. *Tympanidium staurocircum*, n. sp.

Shell with sixteen gates; the four lateral gates double, bisected by an incomplete equatorial ring. Basal and mitral gates of the shell of about equal size, roundish. Equatorial outline of the shell violin-shaped, with a sagittal constriction. All rods of the shell armed with short irregular spines.

*Dimensions.*—Transverse axis of the shell 0·12, sagittal axis 0·06.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

Subfamily 2. PARATYMPANIDA, Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two fenestrated horizontal rings, which are connected by a variable number of vertical rods or columellæ. The shell therefore becomes more completely latticed than in the other Tympanida, and approaches that of the Spyroidea.

Genus 432. *Paratympanum*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two latticed horizontal rings, connected by numerous descending and diverging columellæ; mitral ring smaller than the basal ring.

The genus *Paratympanum* and the following nearly allied *Lithotympanum* form together the small subfamily of Paratympanida, distinguished from the other Tympanida by the fenestration of the two parallel horizontal rings. These rings in *Lithotympanum* are both equal, whilst in *Paratympanum* the basal ring is larger than the mitral ring; therefore the connecting rods or columellæ are in the former parallel and vertical, in the latter divergent and descending. Two opposite ones of these columellæ are parts of the primary sagittal ring, two others are parts of the lateral or frontal ring, whilst the remainder are afterwards intercalated. *Paratympanum* may be derived from *Dystympanium* by fenestration of the basal ring.

1. *Paratympanum hexastylum*, n. sp.

Six divergent columellæ, about as long as the diameter of the hexagonal mitral ring, connect it with the larger hexagonal basal ring. Lattice of the mitral ring hemispherical, with six roundish pores, surrounding a central apical horn. Lattice of the basal ring with one large central pore, surrounded by numerous peripheral pores. Rings and rods smooth, without spines.

*Dimensions.*—Length of the shell 0·07; breadth of the mitral ring 0·06, of the basal ring 0·09.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Paratympanum octostylum*, n. sp. (Pl. 94, fig. 14).

Eight divergent columellæ, about as long as the diameter of the octagonal mitral ring, connect it with the larger circular basal ring, and bear at each end a divergent, strong, conical spine. Lattice-plate of both rings slightly convex, with numerous subregular circular pores, smooth, without surface spines.

*Dimensions.*—Breadth of the mitral ring 0·06, of the basal ring 0·09.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Paratympanum decastylum*, n. sp.

Ten divergent columellæ, only half as long as the diameter of the decagonal mitral ring, connect it with the larger circular basal ring. Lattice-plate of the mitral ring nearly hemispherical of the basal ring flat, both with numerous irregular roundish pores and scattered spines. Margin of both rings spiny.

*Dimensions.*—Breadth of the mitral ring 0·08, of the basal ring 0·1.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

[1] *Paratympanum* = Side-drum; παρά, τύμπανον.

Genus 433. *Lithotympanum*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two latticed horizontal rings, connected by numerous parallel and vertical columellæ; mitral and basal rings of equal size.

The genus *Lithotympanum* has the form of a cylindrical drum, the two fundamental faces of which (the mitral and basal gates) are closed by lattice-work. Both horizontal rings are equal, whilst in the preceding *Paratympanum* the basal gate is larger than the mitral. It may be derived from the latter by equalisation of these two rings, or directly from *Dystympanium* by fenestration of the basal ring.

1. *Lithotympanum tuberosum*, n. sp. (Pl. 83, fig. 1).

Both lattice-plates slightly convex; the mitral plate with six larger marginal pores and one central pore separated by numerous smaller pores; the basal plate with seven large pores only (one central and six peripheral). Surface and margin of the plates uneven, with roundish prominent dimpled tubercles. Both rings connected by ten to twelve simple cylindrical vertical columellæ.

*Dimensions.*—Length of the shell 0·13, breadth 0·1.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Lithotympanum spinosum*, n. sp.

Both lattice-plates flat, with numerous irregular roundish pores of variable size. Surface thorny. Margin with numerous irregular spines, directed upwards on the mitral, downwards on the basal plate. Both rings connected by eight simple cylindrical vertical columellæ.

*Dimensions.*—Length of the shell 0·12, breadth 0·08.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

Subfamily 3. DYSTYMPANIDA, Haeckel.

*Definition.*—Tympanida with fenestrated mitral ring and simple open basal ring; both horizontal rings connected by numerous vertical or divergent columellæ.

Genus 434. *Dystympanium*,[2] n. gen.

*Definition.*—Tympanida with two horizontal rings, connected by numerous (six to eight or more) divergent columellæ. The upper mitral ring is smaller and latticed, the lower basal ring larger and open.

[1] *Lithotympanum* = Drum of silex; λίθος, τύμπανον.

[2] *Dystympanium* = Hideous drum; δύς, τυμπάνιον.

The genus *Dystympanium*, representing a peculiar subfamily, differs from all other Tympanida in the different shape of the two parallel horizontal rings. The upper or mitral ring is closed by a lattice-plate (as in *Paratympanum*), the lower or basal ring is simple and open (as in *Eutympanium*). *Dystympanium* may therefore be regarded as an intermediate form between these two genera, and may perhaps be derived from *Paratympanum* by loss of the lower lattice-plate.

1. *Dystympanium dictyocha*, n. sp. (Pl. 94, figs. 15, 16).

Basal ring circular, with eighteen to twenty short conical divergent spines. Mitral ring about two-thirds as broad, hexagonal, with six ascending spines on the six corners. The latter are connected with the former by six simple, straight, obliquely descending columellæ, about as long as the diameter of the mitral ring. Mitral lattice-plate slightly convex, with seven roundish pores (six peripheral pores around a central pore).

*Dimensions.*—Diameter of the basal ring 0·09, mitral ring 0·06; length of the columellæ 0·05.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

2. *Dystympanium distephanus*, n. sp.

Basal ring hexagonal, with six larger spines at the six corners, and numerous smaller ones between them. Mitral ring half as broad as the basal ring, also with six angular spines. The latter are connected with the former by six divergent curved columellæ, about as long as the diameter of the basal ring. Mitral lattice-plate flat, with irregular roundish pores.

*Dimensions.*—Diameter of the basal ring 0·1, mitral ring 0·05; length of the columellæ 0·09.

*Habitat.*—Equatorial Atlantic, Station 347, depth 2250 fathoms.

3. *Dystympanium medusa*, n. sp.

Basal ring circular, with eight larger and numerous smaller divergent spines. Mitral ring two-thirds as broad as the basal ring, octagonal, with eight conical ascending spines on the eight corners. The latter are connected with the former by eight divergent, curved columellæ, as long as the diameter of the mitral ring. Mitral lattice-plate nearly hemispherical, with nine circular pores (eight peripheral pores around one central pore).

*Dimensions.*—Diameter of the basal ring 0·12, mitral ring 0·08; length of the columellæ 0·09.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

## Subfamily 4. Eutympanida, Haeckel.

*Definition.*—Tympanida with two simple horizontal rings, which are connected by a variable number of vertical rods or columellæ. Therefore the shell exhibits a large simple mitral gate on the upper, and a large simple basal gate on the lower side: between the two a variable number of lateral gates.

Genus 435. *Parastephanus*, Haeckel, 1881, Prodromus, p. 446.

*Definition.*—Tympanida with two simple horizontal rings, connected by two vertical columellæ.

The genus *Parastephanus* is the simplest among the Eutympanida, and exhibits only two vertical rods or columellæ, which connect the two parallel horizontal rings. One of these latter must be regarded as the mitral or superior ring, the other as the basal or inferior ring; whilst the two parallel columellæ, connecting both, are the remaining vertical parts of the sagittal ring, the upper and lower parts of which are lost. By loss of the latter *Parastephanus* has probably been derived from *Protympanium*.

1. *Parastephanus circularis*, n. sp.

Two horizontal rings smooth, circular, of equal size, connected by two curved smooth columellæ, which are somewhat shorter than the diameter of the rings.

*Dimensions.*—Diameter of the rings 0·08, length of the columellæ 0·06.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

2. *Parastephanus quadrispinus*, n. sp. (Pl. 93, fig. 21).

Two horizontal rings smooth, elliptical or nearly circular, of equal size, connected by two vertical, slightly curved columellæ, which are about as long as the radius of the rings. Each ring bears two simple lateral spines, which in the mitral ring are curved downwards, in the basal ring upwards, possibly the last remains of a reduced frontal ring.

*Dimensions.*—Diameter of the rings 0·09, length of the columellæ 0·05.

*Habitat.*—North Pacific, Station 236, surface.

3. *Parastephanus asymmetricus*, n. sp. (Pl. 82, fig. 10).

Two horizontal rings thorny, of equal size, irregularly ovate or nearly semicircular, and of somewhat asymmetrical form. The two connecting parallel columellæ are straight, cylindrical, about as long as the diameter of the rings. The peculiar asymmetry in the form of the rings raises the possibility that the two columellæ in this species are the remaining parts of a frontal ring, and that the sagittal ring has altogether disappeared. In this case the convex half of both rings would be the ventral, the straight half the dorsal part.

*Dimensions.*—Diameter of the rings 0·1, length of the columellæ 0·08.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

4. *Parastephanus dispar*, n. sp.

Two horizontal rings elliptical, thorny, of different sizes, the basal ring one and a half times as broad as the mitral ring. The two connecting columellæ are curved, somewhat longer than the diameter of the mitral ring.

*Dimensions.*—Diameter of the basal ring 0·09, mitral 0·06; length of the columellæ 0·07.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

Genus 436. *Prismatium*,[1] Haeckel, 1862, Monogr. d. Radiol., p. 270.

*Definition.*—Tympanida with two simple horizontal rings, connected by three vertical columellæ.

The genus *Prismatium* was hitherto the only known form of the Tympanida, and the only species described in 1862 in my Monograph was *Prismatium tripleurum* (*loc. cit.*, p. 270, pl. iv. fig. 6). A new species from the Challenger collection (Pl. 93, fig. 22), *Prismatium tripodium*, explains the true structure of this remarkable genus. The skeleton is composed of nine siliceous rods, corresponding to the edges of a trilateral prism. Six of these are horizontal, and enclose the two parallel triangular horizontal gates, the superior of which is formed by the mitral or coryphal, and the inferior by the basal or cortinar ring. The three other rods are vertical and nearly parallel, and connect (as lateral edges of the prism) the corresponding corners of the two parallel horizontal triangles. Two of these vertical columellæ, together with the two horizontal parallel rods connecting them, represent the complete frontal ring, whilst the third vertical columella is the posterior half of the sagittal ring, the other parts of which are lost.

1. *Prismatium tripodium*, n. sp. (Pl. 93, fig. 22).

Mitral ring triangular, somewhat smaller than the triangular basal ring, both connected at the corners by three vertical, slightly curved columellæ. From the six corners arise six radial spines of different size and form; the two paired spines of the mitral ring are simple and very small, whilst those of the basal ring are three times as long and bear a lateral branch. The odd spine of the third corner is on both rings larger, and distinguished by some thorns. This difference seems to indicate that these two odd spines correspond to the apical horn and the caudal foot of *Cortina*, and the columella between them is the rest of the reduced sagittal ring. In this case the quadrangular vertical ring, which is composed of the two paired columellæ and the two connecting horizontal rods, would be probably the frontal ring.

*Dimensions.*—Length of the shell 0·09, breadth 0·07.

*Habitat.*—Equatorial Atlantic, Station 347, surface.

[1] *Prismatium* = A small prism; πρισμάτιον.

2. *Prismatium tripleurum*, Haeckel.

*Prismatium tripleurum*, Haeckel, 1862, Monogr. d. Radiol., p. 270, Taf. iv. fig. 6.
*Acanthodesmia prismatium*, Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 799.

Mitral and basal rings of equal size, equilateral triangular, both connected at the corners by three vertical equal columellæ. From the six corners arise six short, equal, conical radial spines. The nine rods of the shell correspond to the nine edges of a triangular equilateral prism.

*Dimensions.*—Length of the shell 0·044, breadth 0·032.

*Habitat.*—Mediterranean (Messina), surface.

## Genus 437. *Pseudocubus*,[1] n. gen.

*Definition.*—Tympanida with two simple horizontal rings of different sizes, connected by four divergent columellæ.

The genus *Pseudocubus* exhibits the characteristic form of an obelisk, or a truncated four-sided pyramid. The four edges of this obelisk, or the four "columellæ," are the remaining parts of the two incomplete vertical rings; two opposite edges are the dorsal and ventral rod of the sagittal ring; the two alternate edges between these are the lateral rods of the frontal ring. The two horizontal rings, which become connected by the four divergent columellæ, are the smaller mitral ring and the larger basal ring; both are either square or nearly circular.

1. *Pseudocubus obeliscus*, n. sp. (Pl. 94, fig. 11).

Mitral ring square, with circular gate and two divergent simple spines on each corner. Basal ring twice as broad, square, with four convex sides and one simple spine on each corner. Four columellæ straight. All twelve rods with three smooth edges.

*Dimensions.*—Breadth of the mitral ring 0·02, of the basal ring 0·05.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Pseudocubus octostylus*, n. sp.

Mitral ring square, with one stout pyramidal spine on each corner. Basal ring twice as broad, square, also with a single strong spine on each corner. Four columellæ straight. All twelve rods with three smooth edges.

*Dimensions.*—Breadth of the mitral ring 0·04, of the basal ring 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

[1] *Pseudocubus*=False cube; ψεῦδος, κῦβος.

3. *Pseudocubus hexapylus*, n. sp. (Pl. 94, fig. 12).

Mitral ring circular, two-thirds as broad as the subcircular, or nearly square, basal ring; both rings with a simple spine on the two sagittal corners (dorsal and ventral), with a forked or branched larger spine on the two lateral corners (right and left). All twelve rods more or less curved and thorny.

*Dimensions.*—Breadth of the mitral ring 0·07, of the basal ring 0·1.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 438. *Lithocubus*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two simple horizontal rings of equal size, connected by four parallel vertical columellæ.

The genus *Lithocubus* is very remarkable for the regular cubical form of the skeleton, which is composed of twelve siliceous rods, corresponding to the twelve edges of a cube. Eight of these are horizontal, and enclose the two parallel square horizontal gates, the superior mitral and the inferior basal gate. The four other rods are vertical, parallel, and connect (as lateral edges of the cube) the corresponding corners of the two horizontal squares. Two opposite ones of these four vertical columellæ are the remaining halves of the incomplete sagittal ring; the two alternate are the remaining halves of the incomplete frontal ring. The four lateral gates between these four columellæ are also square or rectangular, and either of the same size as the two horizontal gates, or somewhat larger. *Lithocubus* may be derived from *Acrocubus* by reduction of the coryphal and the basal part of the primary sagittal ring, the only remaining parts of which are the anterior and the posterior columellæ.

1. *Lithocubus geometricus*, n. sp. (Pl. 94, fig. 13).

The twelve rods, corresponding to the edges of the geometrical cube, are straight and smooth; the eight corners provided with a small conical thorn. The shell exhibits six equal square sides, and represents therefore exactly the geometrical form of a cube.

*Dimensions.*—Diameter of the cube 0·05; thickness of the bars 0·008.

*Habitat.*—Tropical Pacific, Station 224, depth 1850 fathoms.

2. *Lithocubus octacanthus*, n. sp.

The twelve rods of the cubical shell are slightly curved, convex, smooth, as in the similar preceding species. It differs from that in the development of eight slender radial spines, arising from the eight corners of the geometrical cube, from two to three times as long as its diameter, and lying opposite in pairs in its diagonals.

*Dimensions.*—Diameter of the cube 0·06; length of the spines 0·15.

*Habitat.*—North Atlantic, Canary Islands, surface.

[1] *Lithocubus*=Cube of silex; λίθος, κύβος.

3. *Lithocubus vinculatus*, Haeckel.

*Acanthodesmia vinculata*, J. Müller, 1856 (*partim*), Abhandl. d. k. Akad. d. Wiss. Berlin, Taf. i. fig. 7 (not 4–6).

The twelve rods of the cubical shell are curved and armed with scattered, simple, short spines. The figure 7 of Johannes Müller (*loc. cit.*) corresponds exactly to the Mediterranean form observed by me at Portofino, and is quite different from his true *Acanthodesmia vinculata* (*loc. cit.*, figs. 4–6), so that I have no doubt he did observe these two different species (compare above, p. 975).

*Dimensions.*—Diameter of the cube 0·07; length of the spines 0·02.

*Habitat.*—Mediterranean (Nice, Portofino).

4. *Lithocubus astragalus*, n. sp. (Pl. 82, fig. 12).

The twelve rods of the cubical shell are stout and slightly curved, armed with numerous, simple, and irregularly branched spines. Eight larger spines, branched like a deer's antler, arise from the eight corners of the cube.

*Dimensions.*—Diameter of the cube 0·1 to 0·12; length of the corner spines 0·05 to 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 439. *Circotympanum*,[1] n. gen.

*Definition.*—Tympanida with two simple different horizontal rings, connected by numerous (six to eight or more) divergent columellæ.

The genus *Circotympanum* comprises those Tympanida in which two simple horizontal rings of different size (an upper smaller "mitral ring," and a lower larger "basal ring") are connected by a variable number of divergent rods or columellæ (at least six or eight). *Circotympanum* is probably derived from *Tympaniscus* or *Tympanidium* by partial reduction of the sagittal ring, the upper (apical) and lower (basal) part of which is lost. The geometrical fundamental form is a truncated pyramid with six to eight or more edges.

1. *Circotympanum hexagonium*, n. sp.

Mitral and basal ring hexagonal, the latter twice as broad as the former, each with a simple small spine on the six corners. Six columellæ nearly straight, as long as the radius of the basal ring. All rods with three prominent edges.

*Dimensions.*—Breadth of the mitral ring 0·06, of the basal ring 0·11.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

[1] *Circotympanum* = Drum with rings; κίρκος, τύμπανον.

2. *Circotympanum octogonium*, n. sp. (Pl. 94, fig. 17).

Mitral and basal rings octagonal, the latter one and a half times as broad as the former. Eight columellæ slightly curved, thorny. The mitral ring bears on each corner a short ascending spine, the basal ring a larger, thorny, obliquely descending spine, which has some recurved thorns on the upper edge. All rods more or less thorny.

*Dimensions.*—Breadth of the mitral ring 0·06, of the basal ring 0·09.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Circotympanum decagonium*, n. sp.

Mitral and basal rings circular, the latter nearly twice as broad as the former, both armed with scattered irregular thorns. Ten columellæ smooth, curved.

*Dimensions.*—Breadth of the mitral ring 0·07, of the basal ring 0·12.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

## Genus 440. *Eutympanium*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Tympanida with two simple equal horizontal rings, connected by numerous (six to eight or more) parallel and vertical columellæ.

The genus *Eutympanium* contains those Tympanida in which the drum-shaped shell is composed of two simple, parallel and equal horizontal rings, and numerous vertical and parallel rods or columellæ connecting them. The number of the latter is at least six or eight. Two opposite of these must be regarded as remaining vertical parts of the sagittal ring, two others as parts of the frontal ring, whilst the other columellæ (between the former and the latter) are secondary and intercalated. Therefore *Eutympanium* may be derived from *Tympanidium* by reduction and loss of the apical and basal parts of the sagittal ring.

1. *Eutympanium musicantum*, n. sp. (Pl. 83, fig. 2).

Eight parallel and vertical columellæ, simple, straight and smooth. Both horizontal rings equal, circular, each armed with eight to twelve short conical thorns.

*Dimensions.*—Height of the shell 0·09, breadth 0·07.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

[1] *Eutympanium* = Nice small drum; εὖ, τυμπάνιον.

2. *Eutympanium octonarium*, n. sp.

Eight vertical columellæ slightly curved, thorny. Both horizontal rings equal, octagonal, each armed with eight large, irregularly-branched spines, which on the mitral ring are directed obliquely upwards, on the basal ring downwards.

*Dimensions.*—Height of the shell 0·12, breadth 0·1.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Eutympanium coronarium*, n. sp.

Eight thorny columellæ, obliquely descending and curved like a bow, divergent in the upper part, convergent in the lower. Basal ring circular, mitral ring octagonal. Both horizontal rings armed with eight stout thorny spines, which on the mitral ring are smaller and directed obliquely upwards, on the basal ring larger and directed downwards, each with a recurved hook.

*Dimensions.*—Height of the shell 0·08, breadth 0·06.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

4. *Eutympanium militare*, n. sp. (Pl. 82, fig. 11).

Ten parallel and vertical columellæ straight and smooth, cylindrical. Both horizontal rings equal, circular, armed with numerous short conical spines, divergent in all directions. Ten to twenty spines on each ring larger than the others.

*Dimensions.*—Height of the shell 0·1, breadth 0·08.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

5. *Eutympanium dodecarium*, n. sp.

Twelve vertical columellæ, slightly curved, smooth. Mitral and basal rings circular, both horizontal rings armed with twelve stout, irregularly-branched spines, which are prolongations of the columellæ, and on the mitral ring directed upwards, on the basal ring downwards.

*Dimensions.*—Height of the shell 0·13, breadth 0·1.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

## Order VI. CYRTELLARIA, Haeckel, 1881.

*Definition.*—NASSELLARIA with a complete lattice-shell enveloping the central capsule.

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### Suborder I. SPYROIDEA, Haeckel.

*Spyridina*, Ehrenberg (*pro parte*), 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.
*Zygocyrtida*, Haeckel, 1862, Monogr. d. Radiol., p. 291.
*Zygocyrtida*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 501.
*Acanthodesmida*, R. Hertwig, 1879, Organismus der Radiol., p. 68.
*Spyrida* vel *Spyroidea*, Haeckel, 1881, Prodromus, p. 440.

*Definition.*—NASSELLARIA with a complete lattice-shell, exhibiting constantly a bilocular cephalis with a sagittal constriction.

The suborder Spyroidea, and the two following closely allied suborders, Botryodea and Cyrtoidea, represent together that large group of Radiolaria which I first described in my Monograph (1862, pp. 272, 280) as the family Cyrtida, but afterwards as a separate order (or sublegion) under the name Cyrtellaria (1883, Jena. Sitzungsber., Feb. 16, p. 18). This group comprises all those MONOPYLEA or NASSELLARIA which possess a complete lattice-shell, whilst the preceding Plectellaria never develop a perfect fenestrated shell enveloping the central capsule. The Spyroidea differ from the other Cyrtellaria (Botryodea and Cyrtoidea) in the bilocular shape of the cephalis, which is bisected by the sagittal ring and a corresponding longitudinal constriction into two symmetrical halves.

The Spyroidea appear in the first system of Polycystina of Ehrenberg (1847, *loc. cit.*, pp. 53, 54) as the fourth of his seven families, under the name Spyridina, with the following definition:—"Testæ nucleo destitutæ (associatæ et coalitæ); cellulæ binæ clathratæ, nucis forma amplæ, strictura longitudinali levius discretæ." Ehrenberg united them with his "Polycystina composita or SPUMELLARIA" and separated them from the closely allied "Polycystina solitaria or NASSELLARIA." He distinguished among them five genera, two of which have no external appendages (*Dictyospyris* and *Pleurospyris*), whilst the other three possess spiny or lamellar appendages (*Ceratospyris*, *Cladospyris*, and *Petalospyris*). These five genera and the accompanying definitions were also repeated in the same terms in the last system of Ehrenberg (1875, *loc. cit.*, p. 157). In my Monograph (1862, pp. 280, 291) the Spyroidea are enumerated as a sub-

family of the Cyrtida, under the name Zygocyrtida, with the following definition:—"Lattice-shell divided by an annular sagittal longitudinal constriction into two neighbouring equal joints or chambers." I adopted at that time the above five genera of Ehrenberg, only eight species of which were known.

Richard Hertwig gave in 1879 the first accurate description of the central capsule of the Spyroidea, and demonstrated that they possess the same characteristic structure of the capsule, with a porochora and a podoconus, that is common to all MONOPYLEA. He separated the Zygocyrtida from the other Cyrtida, and united them with the Stephoidea (*Lithocircus*) in the family Acanthodesmida. In my Prodromus (1881, p. 440) I adopted that division and put the "Spyrida or Spyroidea" as a separate family between the Cyrtoidea and Stephoidea. I there gave the following definition:—*Monopylaria gemina*, testa silicea clathrata gemina, cameris binis juxta compositis, annulo verticali sagittali contiguis, capsula centrali a testa inclusa. Promorpha dipleura vel bilaterali, dextro et sinistro antimero symmetricis, plano sagittali annuloque separatis. Polum superiorem axis verticalis vel principalis plerumque spina apicalis (vel occipitalis) occupat, polum inferiorem ostium clathratum (poris tribus aut quatuor aut pluribus) et spina caudalis (posterior). Ad dextram et sinistram duæ spinæ laterales distant. Ab hac forma tripoda (Monocyrtida triradiata acuta cum annulo mediano) diversæ Spyridum formæ derivandæ sunt." I there divided the Spyrida into seven subfamilies and forty-eight genera. Bütschli in 1882 published accurate researches on the Zygocyrtida in his Beiträge zur Kenntniss der Radiolarien-Skelete, insbesondere der der Cyrtida (Zeitschr. f. wiss. Zool., vol. xxxvi. p. 501, Taf. xxxii.). He gave a very exact anatomical description of the skeleton of several fossil Spyroidea of Barbados, and pointed out their close affinity to the Acanthodesmida on the one hand, and to the Cyrtida on the other. Regarding their phylogenetical relation, he supposed that the Zygocyrtida have descended from the Acanthodesmida (our Stephoidea) and are the ancestors of all other Cyrtida. The best part of this valuable paper of Bütschli is his exact description of the sagittal ring and its apophyses, producing the basal plate; and the general conception thus derived of the essential parts of the skeleton in all MONOPYLEA, bearing a sagittal ring. But his general conclusions were partly erroneous, since the fossil Spyroidea and Cyrtoidea of Barbados, upon which they were founded, contain only the minority of genera of the large group; and many important and typical forms remained unknown to him.

The numerous new genera discovered in the rich collection of the Challenger, and mainly in the wonderful Radiolarian ooze of the Central Pacific (Stations 263 to 274) throw a new light upon the complicated affinities of the whole group, and manifest a far greater richness in developmental variations and admirable morphological productions than Bütschli could suppose. The following description, however, must remain very incomplete, since the exact and thorough study of all individual forms, in the same manner as

Bütschli had done in the case of a small number of species, would require several years. I can therefore only give the basis of further researches.

In the majority of Spyroidea the three essential elements of the Nassellarian skeleton are easily recognisable, viz.:—A, the vertical sagittal ring of the Stephoidea; B, the basal tripod of the Plectoidea; and C, the latticed cephalis of the Cyrtellaria. These three elements are constantly so combined that the primary sagittal ring bisects the cavity of the lattice-shell and produces an external, longitudinal, more or less distinct constriction, separating the lateral inflated halves of the bilocular cephalis; while the three divergent feet of the basal tripod descend from the cortinar or basal plate of the cephalis. The number of the feet is often augmented; they are rarely wanting (probably reduced). The sagittal ring is constantly present, though its relation to the shell-wall exhibits many modifications. The bilocular form of the fenestrated cephalis, with its sagittal constriction, is characteristic of all true Spyroidea, and separates them from the Botryodea (with multilobate cephalis) on the one hand, and from the Cyrtoidea (with simple cephalis) on the other. There are, however, some intermediate forms between these three suborders of Cyrtellaria, which show a direct transition to one another. Almost constantly the length of the three dimensive axes in the cephalis of the Spyroidea is so different that the lateral or frontal axis is the longest, the sagittal or dorso-ventral axis the shortest, and the principal or longitudinal axis intermediate between them. As in all dipleuric or bilaterally symmetrical forms, the two poles of the frontal axis are equal, whilst the two poles of the sagittal and of the principal axis are more or less different. In only a few forms of Spyroidea these differences are difficult to make out; usually the dorsal side is distinctly different from the ventral, and the apical side from the basal. A perfect knowledge of the dipleuric shell requires therefore accurate observation from all six sides.

The suborder of Spyroidea is here divided into four different families. In the first and original family, the Zygospyrida, the shell is represented by the bilocular cephalis only. The second family, Tholospyrida, is distinguished by a fenestrated cupola or galea, a hemispherical or conical dome, arising from the upper or coryphal face of the cephalis. In the third family, Phormospyrida, a thorax is developed, or a fenestrated basal chamber, arising from the lower or basal face of the cephalis. The fourth family, Androspyrida, combines the characters of the second and the third family, a galea arising from the upper and a thorax from the lower face of the cephalis.

The bilocular cephalis, as the most important and constant part of the skeleton in all Spyroidea, requires a further general consideration. Its lattice-work, very variable in the numerous species, is usually more or less different on the six sides of the nut-shaped shell. Its most important part is the horizontal basal plate or lower face, and the sagittal ring arising from it in the vertical median plane. This part of the shell corresponds exactly to the skeleton of the Semantida, and exhibits the same modifications

as in that family; it is therefore probable that the majority of the Spyroidea (if not the whole group) have been derived directly from the Semantida by further development of network from the fenestrated ring of *Clathrocircus*. Whilst in this latter Semantid the two lateral sides of the central capsule remain naked, in the Spyroidea they become enclosed and covered by lattice-work, which arises on the right and left from the ring. In some forms, however, as in the *Ceratospyris acuminata* of Hertwig, and in my Perispyrida, the frontal ring also of the Coronida and the mitral ring of the Tympanida appear as the initial parts of a complete latticed cephalis.

The basal plate of the cephalis, or the "cortinar plate," the "Basal-Scheibe" of Bütschli, has constantly, according to this author, two pairs of pores, an anterior smaller pair of jugular pores (the pores I of Bütschli) and a posterior larger pair of cardinal pores (the pores II in his description) (compare Pl. 95, figs. 3, 6). This applies to the majority of Spyroidea, but by no means to the whole group. We find basal plates with two pores only (Pl. 95, fig. 1), with three pores (figs. 2, 5), with six pores (figs. 4, 7), with nine pores (Pl. 87, fig. 2), &c. The forms with two basal pores may be derived directly from *Semantis* (Pl. 92, figs. 1, 2); the common forms with four pores from *Semantrum* (figs. 3–5); the rarer forms with six pores from *Semantidium* (figs. 6, 7); and the forms with three pores from *Cortiniscus*, &c. In this as well as in other respects the variety of different forms and of developmental variations is far greater than Bütschli (1882, *loc. cit.*) supposed. The bars between the pores of the basal plate possess the same value and the same names as in the Semantida (compare above, p. 954).

The coryphal plate of the cephalis, its upper or apical lattice-plate, does not exhibit such important differences as the opposite basal plate, is far less variable, and is usually pierced by numerous, smaller pores. Some larger pores lie, often in pairs, on the right and left side of the sagittal constriction, and have in some groups a regular form and disposition. Either in the middle of the coryphal plate, or (usually) nearer to its dorsal margin, there arises in the majority of Spyroidea an apical horn, directed either vertically or more or less obliquely backwards. In many Spyroidea three horns are developed in the coryphal plate, the odd middle apical horn and two paired frontal or lateral horns arising on each side of the latter and directed more forwards (Pl. 84, figs. 9–12). Sometimes the apical horn disappears, while the two frontal horns remain (Pl. 95, fig. 12).

The anterior or ventral plate of the cephalis (the "Hinterseite" of Bütschli), and the posterior or dorsal side (the "Vorderseite" of that author), exhibit in the majority of Spyroidea more or less marked differences in the number, form, and disposition of their pores, which require a far more accurate description than is here possible. Usually the sagittal constriction of these two plates, produced by the primary vertical ring, is deeper and sharper in the middle of the ventral than in that of the dorsal plate. On both sides of the ring there appear in each plate usually two or three pairs of larger pores, whilst numerous smaller pores are situated towards the lateral sides. We may

distinguish the large pores of the ventral plate as facial pores (upper orbital, middle nasal, and lower maxillary pores), and the opposite large pores of the dorsal plate as occipital pores (upper epoccipital, middle mesoccipital, and lower suboccipital pores). A closer comparison of these pores, and of the separating bars in the numerous Spyroidea, may show a regularity of development similar to that offered by the homologies of the parts in the skeleton of the Echinodermata, or of the bones in the skull of the Vertebrata.

The two convex lateral plates of the cephalis, or the right and left sides, both symmetrically equal, do not exhibit the same regularity in the shape, number, and disposition of the pores that the four other sides do. Usually their pores are much smaller and more numerous. In very few forms only a distinct frontal ring is visible (corresponding to that of the Coronida), and in this case the lateral pores are sometimes disposed symmetrically on both sides of this ring. These Spyroidea may have arisen directly from corresponding forms of Coronida.

The sagittal ring (or the primary vertical ring, inherited from the Stephanida and Semantida, shows in the Spyroidea great variety in its form and in its relation to the cephalis. These variations are far greater than Bütschli (1882, *loc. cit.*) supposed. We may distinguish the following six principal cases:—A. The ring lies completely in the wall of the cephalis, and causes a deep sagittal constriction in it. In this case the lower part or basal segment of the ring separates the basal pores into pairs; its anterior part or ventral rod the facial pores; its upper part or coryphal rod the apical pores; and its posterior part or dorsal rod the occipital pores. No part of the ring is free in the shell-cavity. B. The greater part of the ring lies enclosed in the shell-wall; only its dorsal rod arises free in the shell-cavity and ascends vertically or obliquely to the apex, where it is usually prolonged into the apical horn. This seems to be the most common case. C. The coryphal and the basal part of the ring lie enclosed in the shell-wall, with its dorsal and ventral rod free in the shell-cavity; the dorsal rod ascends vertically to the apex, the ventral rod obliquely upwards to the upper part of the facial plate (the nasal or orbital region). This case, regarded by Bütschli as the usual one, is far less common than he supposed. D. The greater part of the ring lies free in the shell-cavity, its basal rod only is enclosed in the shell-wall, and separates the right from the left group of the cortinar pores. This case seems to be rarer than the preceding. E. The whole ring lies free in the shell-cavity, and is connected with the sagittal constriction of the shell-wall by numerous short radial beams. The distance of the shell-wall from the enclosed ring is usually least on the basal rod, and greatest on the dorsal rod. F. The whole ring lies free in the shell-cavity (as in the preceding case), and is connected by numerous short radial beams with a secondary larger, concentric sagittal ring, which is developed in the longitudinal constriction of the shell-wall.

Comparing these six principal cases, in respect of the relation of the primary sagittal ring to the cephalis of the Spyroidea, we may suppose that they represent together a continuous phylogenetical series, of which the first (A) is the original, and the last (F) the latest case; and that the true cause of the various changes is a successive separation of the ring, which becomes more and more free and independent from the lattice-plate of the cephalis. Since the intimate study of the structure of the cephalis in many Spyroidea is very difficult, it requires further accurate observations (from all six sides of the shell). There are also some other more difficult complications of its structure, which cannot be solved without exact study and extended comparison.

Of peculiar importance for the differentiation of the numerous genera of the Spyroidea are the basal feet or the descending and diverging apophyses, which are developed from the base of their cephalis. In general they exhibit the same typical shape which we find in the Plectellaria as well as in the Cyrtoidea, and which we regard therefore as an important common character of the majority of NASSELLARIA. We may therefore distinguish here also the three primary, and the other ones as secondary feet. The three primary feet, or the "cortinar feet," are the same that we found in the Plagonida and Plectanida, in *Cortina* and *Cortiniscus* among the Stephoidea, and in the majority of Cyrtoidea. They also reappear in the same characteristic disposition and connection with the basal plate of the cephalis, in the majority of Spyroidea. The odd caudal foot ($c$) is the lower prolongation of the dorsal rod of the sagittal ring, which is prolonged upwards into the apical horn. The two paired pectoral feet, however ($p'$, $p''$), are the descending prolongations of the coracal rods ($e$) which separate the jugular pores ($i$) from the cardinal pores ($k$) of the cortinar plate (compare Pl. 95, figs. 2–6).

The three cortinar feet are nearly equally developed in the majority of Spyroidea (compare Pls. 84, 89). But often the odd caudal foot exhibits a different shape from that of the two paired pectoral feet, and in many genera of the group it becomes more or less rudimentary. It has quite disappeared in the subfamily Dipospyrida (Pl. 85); here the two pectoral feet only are developed (often excessively), and are usually opposite in the frontal plane. Such dipodal forms, very common in the Spyroidea, are never found in the Cyrtoidea.

The secondary feet, which we contrast with the three primary feet as later productions, exhibit great variations in number and development. Very frequently three interradial secondary feet become developed, alternating with the three primary cortinar or perradial feet, and opposed to them in pairs (Pl. 95, figs. 7, 8). In these hexapodal Spyroidea (or Hexaspyrida) an odd anterior or sternal foot ($z$) is opposite to the odd caudal foot, and two paired posterior or tergal feet ($t_{I}$ $t_{II}$) to the two pectoral feet. When the sternal foot becomes rudimentary or lost, pentapodal forms arise (Pentaspyrida, Pl. 95, figs. 9–11), and when the two odd feet (caudal and sternal) disappear, tetrapodal forms arise with two pairs of feet (Therospyrida, Pl. 89, figs. 5, 6). The latter differ from

those quadrupedal forms in which two opposite sagittal feet (the caudal and sternal) alternate in the form of a cross with two paired lateral or pectoral feet (Tetraspyrida, Pl. 53, figs. 19, 20). In many Spyroidea the number of basal feet is greatly increased, and they form a regular radial corona around the basal plate, like a circle of tentacles (Polyspyrida, Pl. 87). In this latter case the feet are usually flat and lamellar, whilst in the other groups they exhibit a very variable form, as is seen in Pls. 83–89.

*The Central Capsule* of the Spyroidea has been accurately observed in only a few genera, and requires a further exact examination regarding the different modifications which occur in their different families. It is very probable that these will agree with the well known modifications in the corresponding groups of Cyrtoidea. The characteristic Monopylean structure of the capsule (with porochora and podoconus) was first described by Richard Hertwig in his *Ceratospyris acuminata* (*loc. cit.*, p. 72, taf. vii. fig. 2). I found the same afterwards in many other forms. In the Zygospyrida and Tholospyrida the central capsule seems to be usually bilobate (bisected by the sagittal ring), and enclosed in the two chambers of the cephalis. The two lobes of the capsule (right and left) are equal and connected by a smaller middle part, which contains the transverse elliptical nucleus and is enclosed by the sagittal ring; often each lobe contains a large oil-globule. In some forms, however, three or four lobes (sometimes perhaps more) are developed, which pierce the cortinar pores of the basal plate and depend freely between the basal feet (Pl. 53, fig. 19). In the Phormospyrida and Androspyrida the formation of such basal lobes seems to be more frequent; they are here enclosed by the thorax. Usually each lobe contains a large oil-globule. In *Nephrospyris* (Pl. 90) and in some similar genera the central capsule is violin-shaped, deeply bisected by the sagittal ring; in each of the two lobes a series of oil-vesicles is developed at both poles of the transverse axis (figs. 7, 10); the nucleus, a transverse cylindrical body, is placed in the latter. In the periphery of the voluminous calymma of this singular genus a large number of globular cells are developed (figs. 7, 10), probably symbiotic xanthellæ. In some forms of *Nephrospyris* these xanthellæ are enclosed by a peculiar inflated girdle, developed in the periphery of the kidney-shaped skeleton (Pl. 90, figs. 1, 4–6).

### *Synopsis of the Families of* Spyroidea.

| | | |
|---|---|---|
| Shell without thorax; no second shell-joint, developed from the base of the cephalis. | Cephalis without galea (or apical cupola), | 1. Zygospyrida. |
| | Cephalis with a galea (or apical cupola), . | 2. Tholospyrida. |
| Shell with a thorax, or a second shell-joint, developed from the base of the cephalis. | Cephalis without galea (or apical cupola), | 3. Phormospyrida. |
| | Cephalis with a galea (or apical cupola), . | 4. Androspyriea. |

## Family LII. ZYGOSPYRIDA, n. fam. (Pls. 84–87).

*Definition.*—Spyroidea without galea and thorax; the shell consisting of the bilocular cephalis only and its apophyses.

The family Zygospyrida is by far the richest among the four families of Spyroidea, the number of genera in the whole suborder amounting to forty-five, in the former to twenty-eight; and the number of species in the latter to two hundred and thirty-seven, in the former to one hundred and seventy-two. The number of individuals also found in many species of Zygospyrida is far greater than in any species of the three other families. The shell of the Zygospyrida is represented by the bilocular cephalis only, and never develops a galea (as in the Tholospyrida) nor a thorax (as in the Phormospyrida and Androspyrida). The three latter families have therefore been derived from the former as their common ancestral group.

The Zygospyrida are very similar and nearly related to the Monocyrtida, and in both groups the cephalis alone represents the whole shell. Therefore in 1882, Bütschli, in the paper mentioned above (p. 1016), maintained the opinion, that these two groups were identical. But there is this important difference between them, that in the Zygospyrida (as in all Spyroidea) the cephalis is bilocular, with a sagittal constriction, separating the right and left chambers. In the Monocyrtida, however (as in all Cyrtoidea), the cephalis is unilocular, forming a quite simple chamber without sagittal constriction. Correspondingly the primary sagittal ring in all Zygospyrida is well preserved and usually complete, while in the Monocyrtida it is never complete, and often quite absent. Another difference is indicated by the form of the central capsule, which in the Zygospyrida is usually bilobed, and more developed in the frontal axis, whilst in the Monocyrtida it is commonly ovate, and more developed in the principal axis.

The important questions of the origin and phylogenetical relation of these two similar groups of NASSELLARIA form a very complicated and difficult problem, and we do not at present possess the means of solving it. It may be that a part of the Monocyrtida has been derived from the Zygospyrida (as Bütschli erroneously supposes for all), but the contrary is also possible. A third possibility is the independent origin of both groups from the Semantida. But we shall see afterwards, in the description of the Monocyrtida, that a great part of this group may with greater probability be derived from the Plectoidea than from the Stephoidea, and that another part of them has probably been derived quite independently from the Nassellida. Regarding the complicated relations of these similar groups, mentioned above (pp. 892–894), it seems hopeless here to discuss further their difficult affinities; but in any case it seems useful or even necessary to separate the Monocyrtida from the Zygospyrida.

The cephalis of the Zygospyrida possesss all the characteristic features which we have described above as belonging to the Spyroidea in general (p. 1017), and a survey of the Pls. 84–87 exhibits the most important modifications of its shape (compare also Pl. 95, figs. 1–13). Therefore we may avoid useless repetitions by referring to the description given above. We will only point out that the bilocular character of the cephalis (in opposition to the simple cephalis of the Monocyrtida) in the majority of Zygospyrida is apparent on the first view, and that it is always demonstrated by an accurate examination of the sagittal ring and its relation to the longitudinal constriction of the cephalis (compare p. 1019). The basal plate or cortinar plate exhibits usually four typical pores (two smaller jugular, *i*, and two larger cardinal, *k*), but this is by no means a general rule, as Bütschli thought; moreover, instead of four cortinar pores, there are frequently found three or six or some other numbers (compare above, p. 1018).

The top of the cephalis in the majority of Zygospyrida bears an apical horn, as an upper prolongation of the dorsal rod of the sagittal ring; it is often of unusual size and shape (Pl. 85, figs. 5–11; Pl. 95, fig. 8, &c.). In several genera two lateral or frontal horns are developed on both sides of the former (Pl. 84, figs. 9–12; Pl. 86, figs. 5–13). Sometimes these two alone are present, while the original apical horn is lost by reduction (Pl. 95, fig. 12). In other genera the apical face bears no horns; probably they are lost by reduction.

The greatest variety of forms is produced in the Zygospyrida by the different number, disposition, and shape of the feet, or the basal apophyses arising from the base of the cephalis. Regarding these remarkable differences, we may distinguish eight subfamilies. The common ancestral group of all are probably the Tripospyrida, which possess the three typical basal feet of *Cortina* and *Cortiniscus*, an odd caudal and two paired pectoral feet (Pl. 84). From these may be derived the Dipospyrida (Pl. 85) by loss of the caudal foot, the Tetraspyrida by development of an odd sternal foot (Pl. 53, figs. 7, 8, 19), and the Hexaspyrida by development of three secondary interradial between the three primary perradial feet. The Pentaspyrida may have been derived from the latter by loss of the sternal foot (Pl. 95, figs. 9–11), and the Therospyrida by loss of the two sagittal feet (Pl. 89, figs. 5, 6). The Polyspyrida bear numerous (seven to twelve or more, often twenty to thirty) basal feet, forming a corona around the cortinar plate (Pl. 87); they may have been derived from the Tripospyrida or Hexaspyrida by further multiplication of the feet. Finally, the Circospyrida exhibit no feet at all (Pl. 89, figs. 7–12); they may be derived either from one of the preceding groups by complete reduction and loss of the basal apophyses, or directly from those Semantida which have no feet (*Semantis*, *Semantrum*, *Clathrocircus*, &c.).

## *Synopsis of the Genera of Zygospyrida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Tripospyrida. Three basal feet. (One odd caudal and two paired pectoral.) | Apex of the shell with one horn, | | | 441. *Tripospyris.* |
| | Apex of the shell with three horns, | | | 442. *Triceraspyris.* |
| | Apex of the shell without horns, | | | 443. *Tristylospyris.* |
| | Apex with two large coryphal holes, right and left, | | | 444. *Cephalospyris.* |
| II. Subfamily Dipospyrida. Two basal lateral feet. (Originally the two pectoral feet.) | Two feet free, not grown together. | Feet simple, not branched, without lateral spines. | One horn, | 445. *Dipospyris.* |
| | | | No horn, | 446. *Brachiospyris.* |
| | | Feet branched like a tree. | One horn, | 447. *Dendrospyris.* |
| | | Feet with a series of lateral spines. | One horn, | 448. *Dorcadospyris.* |
| | Two feet grown together and uniting to form a ring. Apex with a horn. | Feet simple, | | 449. *Gamospyris* |
| | | Feet with a series of lateral spines, | | 450. *Stephanospyris.* |
| III. Subfamily Tetraspyrida. Two sagittal and two lateral feet. | Feet simple, not branched. | Apex with one horn, | | 451. *Tetraspyris.* |
| | | Apex without a horn, | | 452. *Tessarospyris.* |
| IV. Subfamily Hexaspyrida. Six basal feet. | Two sagittal, two pectoral, and two tergal feet. | Apex with one horn, | | 453. *Hexaspyris.* |
| | | Apex with three horns, | | 454. *Liriospyris.* |
| | | Apex without a horn, | | 455. *Cantharospyris.* |
| V. Subfamily Pentaspyrida. Five basal feet. | One caudal, two pectoral, and two tergal feet. | Apex with one horn, | | 456. *Clathrospyris.* |
| | | Apex with three horns, | | 457. *Ægospyris.* |
| | | Apex without a horn, | | 458. *Pentaspyris.* |
| VI. Subfamily Therospyrida. Four paired lateral feet. (Two pectoral and two tergal.) | Apex with one horn, | | | 459. *Zygospyris.* |
| | Apex with three horns (one apical and two frontal), | | | 460. *Elaphospyris.* |
| | Apex with two lateral or frontal horns, | | | 461. *Taurospyris.* |
| | Apex without a horn, | | | 462. *Therospyris.* |
| VII. Subfamily Polyspyrida. Numerous (seven to twelve or more) basal feet. | Apex with one horn, | | | 463. *Petalospyris.* |
| | Apex with three horns (one apical and two frontal), | | | 464. *Anthospyris.* |
| | Apex with numerous horns, | | | 465. *Ceratospyris.* |
| | Apex without a horn, | | | 466. *Gorgospyris.* |
| VIII. Subfamily Circospyrida. No basal feet. | Apex with one horn, | | | 467. *Circospyris.* |
| | Apex without a horn, | | | 468. *Dictyospyris.* |

Subfamily 1. TRIPOSPYRIDA, Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida tripoda, with three descending basal feet (the same as in *Cortina*, an odd posterior or caudal foot and two paired anterior or pectoral feet).

Genus 441. *Tripospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with three basal feet and one apical horn.

The genus *Tripospyris* (Pl. 84, figs. 1-7) is in the large group of Spyroidea probably the most original and typical form, from which, as a common ancestral form, all other genera of this polymorphous suborder may be derived. The shell is usually shaped like a nut or thorax, and exhibits two paired lateral chambers, which are separated by a distinct sagittal ring and a slighter or deeper sagittal constriction. The dorsal rod of the ring is prolonged at the upper pole into an ascending apical horn, at the lower pole into a descending caudal foot, whilst two paired pectoral or lateral feet arise from the anterior pole of the basal rod. These three divergent basal feet and the apical horn are the same four typical radial spines which we have encountered already in *Plagoniscus* (Plagonida), in *Plectaniscus* (Plectanida), in *Cortina* (Stephanida), and in *Cortiniscus* (Semantida). Compare above, p. 891. From all these Plectellaria, *Tripospyris* differs in the development of a complete bilocular lattice-shell, having the characters of the true Spyroidea. The numerous species of this genus may be placed in different subgenera, according to the different number of collar pores or cortinar pores in the basal plate (two, three, four, six, or more). These differences are very important, however difficult to make out; the following system therefore is a provisional one, and requires further accurate observations.

Subgenus 1. *Tripospyrantha*, Haeckel.

*Definition.*—Basal plate with two large pores only (the primary jugular pores of *Semantis*).

1. *Tripospyris cortina*, n. sp. (Pl. 95, fig. 1).

Shell ovate, smooth, about as long as broad, with slight ovate sagittal stricture, and broad primary ring in its wall. Basal plate with two large kidney-shaped collar pores only (cardinal pores). Facial and occipital plates each with two pairs of large annular pores, and ten to twelve pairs of small lateral pores. Apical horn and the three basal feet of equal length, one and a half times as long as the shell, three-sided prismatic, straight, divergent.

*Dimensions.*—Shell 0·08 long, 0·09 broad; horn and feet 0·15 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

[1] *Tripospyris*=Basket with a tripod; τρίπους, σπυρίς.

2. *Tripospyris cortiniscus*, n. sp. (Pl. 84, fig. 6).

Shell ovate, smooth, one and a third times as long as broad, with sharp ovate sagittal stricture and broad primary ring. Basal plate with two large cardinal pores only. Occipital plate with two pairs of very large pores; facial plate and lateral sides with numerous smaller irregular roundish pores. Apical horn small, conical, curved, half as long as the three basal feet, which are club-shaped and three-edged, with thinner bases and half as long as the shell, strongly divergent.

*Dimensions.*—Shell 0·12 long, 0·09 broad; horn 0·03 long, feet 0·06 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Tripospyris semantis*, n. sp. (Pl. 84, figs. 2, 3).

Shell subspherical, smooth, somewhat broader than long, with slight sagittal stricture and sub-circular parietal primary ring. Basal plate with two large semicircular cardinal pores. Facial and occipital plate each with two pairs of large annular pores and an odd large subapical pore; lateral sides with very numerous small roundish pores. Apical horn and caudal foot club-shaped, half as long as the shell, angular, simple; the two pectoral feet somewhat longer, nearly vertical, and at the distal end with a small incision, nearly forked.

*Dimensions.*—Shell 0·1 long, 0·12 broad; horn and feet 0·05 to 0·07 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

4. *Tripospyris diomma*, n. sp. (Pl. 84, fig. 5).

Shell thorax-shaped, smooth, twice as broad as long, with deep sagittal stricture, two vaulted ovate bosoms and smaller ovate internal primary ring. Basal plate with two large ovate cardinal pores. Facial plate with three pairs, occipital plate with four pairs of large annular pores; the other lattice-work loose, with small and numerous irregular polygonal pores. Apical horn and caudal feet slender and thin, curved, shorter than half the shell; two pectoral feet also small, widely divergent, more or less curved, deeply forked.

*Dimensions.*—Shell 0·1 long, 0·16 broad; horn and feet 0·2 to 0·25 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

## Subgenus 2. *Tripospyrella*, Haeckel.

*Definition.*—Basal plate with three large collar pores (two paired posterior cardinal pores, and an odd anterior sternal pore).

5. *Tripospyris triomma*, Haeckel.

*Ceratospyris triomma*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xxi. fig. 3.

Shell subspherical, tuberculate, with slight sagittal stricture and circular internal ring. Basal plate with three large pores, which are sometimes (but not in every specimen) surrounded by a

circle of very small pores. The other lattice-work with numerous small roundish pores. Apical horn small, oblique, about as long as the shell. Three feet very large, cylindrical, curved, widely divergent, four to five times as long as the shell. (In Ehrenberg's description the caudal foot is erroneously described as "frontal spine"; its figure exhibits the basal plate.)

*Dimensions.*—Shell 0·07 to 0·09 diameter; horn 0·06 long, feet 0·3 to 0·4 long.

*Habitat.*—Fossil in Tertiary rocks of Barbados.

6. *Tripospyris conifera*, n. sp. (Pl. 84, figs. 7, 7*a*).

Shell nearly hemispherical, papillate, with slight sagittal stricture and semicircular internal ring. Basal plate with three large pores (sometimes, as in the figured specimen, with some small accessory peripheral pores). The other lattice-work with subregular circular pores. Apical horn shorter than the three basal feet, but of similar form, like an elegant ovate dimpled cone, spinulate, with a smooth spindle-shaped pedicle, about as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·1 broad; horn 0·06 long, feet 0·08 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

7. *Tripospyris triplecta*, n. sp. (Pl. 95, fig. 2).

Shell thorax-shaped, spiny, with deep sagittal stricture and semicircular internal ring. Basal plate with three large collar pores. Facial plate with four pairs, occipital plate with three pairs of large annular pores; the other pores small, subregular, circular. Apical horn and the feet slender, three-sided pyramidal, about as long as the shell.

*Dimensions.*—Shell 0·1 long, 0·11 broad; horn and feet 0·1 to 0·15 broad.

*Habitat.*—Mediterranean, Corfu (Haeckel), surface.

## Subgenus 3. *Tripospyrissa*, Haeckel.

*Definition.*—Basal plate with two pairs of collar pores (two larger posterior cardinal pores and two smaller anterior jugular pores).

8. *Tripospyris semantrum*, n. sp. (Pl. 95, fig. 3).

Shell thorax-shaped, thorny, with deep sagittal stricture and subcircular ring. Basal plate with four large collar pores (two smaller ovate jugular, and two larger pentagonal cardinal pores). Facial and occipital plates also each with two pairs of large annular pores; lateral sides with smaller irregular polygonal pores. Apical horn and the three feet slender, prismatic, divergent, longer than the shell.

*Dimensions.*—Shell 0·07 long, 0·08 broad; horn and feet 0·11 to 0·13 long.

*Habitat.*—South Atlantic, Cape of Good Hope (Wilhelm Bleek), surface.

9. *Tripospyris capitata*, n. sp. (Pl. 84, fig. 1).

Shell subspherical, spiny, with slight sagittal stricture and ovate internal ring. Basal plate with four large collar pores. Facial plate with three pairs and occipital plate with two pairs of large roundish annular pores; lateral lattice with smaller irregular pores. Apical horn and the three feet subcylindrical, about half as long as the shell, straight, divergent, with a spherical, spinulate knob at the distal end.

*Dimensions.*—Shell 0·09 long, 0·1 broad; horn and feet 0·05 to 0·06 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

10. *Tripospyris clavata*, Haeckel.

*Ceratospyris clavata*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 539, Taf. xxxii. fig. 13, *a–c*.

Shell subspherical, compressed, rough, with slight sagittal stricture and ovate internal primary ring. Basal plate with four large collar pores (fig. 13,*a*, *loc. cit.*). The other lattice-work with irregular small roundish pores. Apical horn and the three feet short and thick, scarcely half as long as the shell, with a roundish spinulate knob at the distal end.

*Dimensions.*—Length of the shell 0·07 long, 0·08 broad; horn and feet 0·02 to 0·03 long.

*Habitat.*—Fossil in Barbados.

11. *Tripospyris tessaromma*, n. sp.

Shell nearly cubical, spiny, with deep sagittal stricture and subcircular ring. Basal plate with four large collar pores. Facial and occipital plates each also with two pairs of large square annular pores; lateral pores irregular polygonal. Apical horn half as long as the feet, which are three times the length of the shell, cylindrical, slightly curved.

*Dimensions.*—Shell 0·1 long, 0·12 broad; horn 0·15 long, feet 0·3 long.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

## Subgenus 4. *Tripospyromma*, Haeckel.

*Definition.*—Basal plate with six or more collar pores. Commonly two small anterior jugular pores, two large middle cardinal pores, and two small posterior cervical pores; sometimes several small accessory collar pores.

12. *Tripospyris hexomma*, n. sp. (Pl. 95, fig. 4).

Shell thorax-shaped, tuberculate, with deep sagittal stricture and semicircular internal primary ring. Basal plate with three pairs of pores. Facial plate with two pairs, occipital plate with four pairs of large annular pores. Lateral pores smaller, irregular, polygonal. Apical horn and caudal foot half as long as the shell and as the two pectoral feet; all four spines cylindrical, two to three times as long as the shell, slightly curved.

*Dimensions.*—Shell 0·1 long, 0·12 broad; horn and feet 0·2 to 0·4 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

13. *Tripospyris semantidium*, n. sp.

Shell nut-shaped, thorny, with sharp sagittal stricture and subcircular ring. Basal plate with three pairs of large pores. Facial and occipital plates each with three pairs of large squarish pores. Lateral pores small and numerous, irregular roundish. Apical horn half as long as the shell and the three feet; all four spines straight, cylindrical, with thickened club-shaped end.

*Dimensions.*—Shell 0·12 long, 0·13 broad; horn 0·06 long, feet 0·15.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

14. *Tripospyris eucolpos*, n. sp. (Pl. 84, fig. 4).

Shell thorax-shaped, smooth, with two vaulted bosoms, separated by a deep sagittal stricture and an internal primary ring. Basal plate constricted, with three pairs of collar pores. The other lattice-work with subregular circular pores. Apical horn and the three feet shorter than the shell, straight, divergent; their inner half thinner, cylindrical, smooth, their outer half an ovate dimpled cone.

*Dimensions.*—Shell 0·1 long, 0·13 broad; horn and feet 0·06 long.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

15. *Tripospyris tribrachiata*, Haeckel.

*Cladospyris tribrachiata*, Ehrenberg, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xxi. fig. 8.

Shell subspherical, smooth, with slight sagittal stricture and numerous, very small circular pores. Basal plate with numerous small pores. Apical horn and the three divergent feet very large and stout, straight, three-sided prismatic, with dentate edges, two to three times as long as the shell.

*Dimensions.*—Shell diameter 0·05; horn and feet 0·1 to 0·15 long.

*Habitat.*—Fossil in Barbados.

16. *Tripospyris furcata*, n. sp. (Pl. 83, fig. 11).

Shell nut-shaped, smooth, with deep sagittal stricture and broad ring. Basal plate with three pairs of small pores. Facial and occipital faces each with a pair of very large holes. Apical horn and caudal foot simple conical, two pectoral feet forked or irregularly branched.

*Dimensions.*—Shell 0·08 long, 0·12 broad; horn and feet 0·05 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 442. *Triceraspyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with three basal feet and three coryphal horns.

The genus *Triceraspyris* has arisen from the preceding ancestral *Tripospyris* by the development of two paired frontal horns, so that the shell here bears six appendages,

[1] *Triceraspyris*=Basket with three horns; τρίκερως, σπυρίς.

three superior or coryphal spines and three inferior or basal spines; two of these are odd and dorsal (the apical horn and the caudal foot), the four others are paired and ventral (the frontal horns and the pectoral feet). The numerous species of this genus may be divided into three subgenera, according to the simple or branched shape of the ascending horns and of the descending feet.

### Subgenus 1. *Triospyris*, Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Horns and feet simple, not branched nor forked.

1. *Triceraspyris tripodiscus*, n. sp.

Shell nut-shaped, tuberculate, with deep sagittal stricture. Pores irregular roundish, two pairs of larger pores on each side of the ring. Basal plate with three large pores. Horns and feet slender cylindrical, straight, divergent; three horns about as long as the shell, three feet twice as long.

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn 0·05 long, feet 0·1.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

2. *Triceraspyris cortiniscus*, n. sp.

Shell subspherical, smooth, with slight sagittal stricture. Pores small and numerous, subregular roundish. Basal plate with two large pores (?). Apical horn conical, short, half as long as the shell and the two lateral horns, which are curved outwards. All three feet equal, cylindrical, strongly curved and divergent, twice to three times as long as the shell.

*Dimensions.*—Shell 0·07 long, 0·08 broad; horn 0·04 to 0·08 long, feet 0·15 to 0·2 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Triceraspyris didiceros*, Haeckel.

*Ceratospyris didiceros*, Ehrenberg, 1875, Abhandl. d. Akad. d. Wiss. Berlin, p. 66, Taf. xxi. fig. 6.

Shell nut-shaped, thorny, with superficial sagittal stricture. Pores large, irregular roundish. Basal plate with four larger pores. Apical horn and caudal foot small, conical, shorter than half the shell. The two frontal horns longer, slender conical. The two pectoral feet very large, cylindrical, nearly parallel, vertical, slightly curved, twice to three times as long as the shell.

*Dimensions.*—Shell 0·07 long, 0·09 broad; two sagittal spines 0·02 long, two lateral horns 0·04 long, two lateral feet 0·15 to 0·25 long.

*Habitat.*—Fossil in Barbados.

### Subgenus 2. *Triospyrium*, Haeckel.

*Definition.*—Horns simple, not branched; feet forked or branched.

4. *Triceraspyris furcata*, Haeckel.

*Ceratospyris furcata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 8.

Shell nut-shaped, tuberculate, with slight sagittal stricture. Pores numerous, irregular roundish. Basal plate with four large pores. Three horns small, conical, shorter than half the shell. Three feet large, cylindrical, curved, about twice as long as the shell, forked at the distal end.

*Dimensions.*—Shell 0·07 long, 0·08 broad; horns 0·02 long, feet 0·1 to 0·12 long.

*Habitat.*—Fossil in Barbados.

5. *Triceraspyris giraffa*, n. sp. (Pl. 84, fig. 11).

Shell nut-shaped, mammillate, with slight sagittal stricture. Pores numerous, subregular circular. Basal plate with nine pores (three larger central and three alternate pairs of smaller peripheral, as in Pl. 87, fig. 2). Three horns equal straight, divergent, shorter than the shell, in the basal half cylindrical, in the distal half spindle-shaped. Three feet cylindrical, twice as long as the shell, nearly parallel, vertical, at the distal end divergent, with a recurved branch near the base.

*Dimensions.*—Shell 0·08 long, 0·1 broad; horns 0·05 to 0·07 long, feet 0·16 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

6. *Triceraspyris gazella*, n. sp. (Pl. 84, fig. 9).

Shell nut-shaped, tuberculate, with sharp sagittal stricture. Pores large, irregular roundish; two or three pairs of larger pores on each side of the ring. Basal plate with three large triangular pores. Three horns simple, about as long as the shell, the apical straight, the two frontal elegantly curved. Three feet somewhat longer, slender, curved, with a recurved branch near the base, repeatedly forked at the distal end.

*Dimensions.*—Shell 0·06 long, 0·09 broad; horn 0·05 long, feet 0·08 long.

*Habitat.*—Indian Ocean (Cocos Islands), surface (Rabbe).

7. *Triceraspyris corallorrhiza*, n. sp. (Pl. 84, fig. 12).

Shell nut-shaped, spiny, with deep sagittal stricture. Pores irregular polygonal or roundish. Basal plate with two large semicircular pores. Three horns slender, simple, about half as long as the shell. Three feet of the same length, slender, divergent, irregularly branched like coral.

*Dimensions.*—Shell 0·06 long, 0·09 broad; horn and feet 0·03 to 0·05 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

8. *Triceraspyris maniculata*, n. sp.

Shell subspherical, smooth, without external sagittal stricture. Pores subregular circular. Basal plate with four large pores (?). Three horns simple, straight, divergent, spindle-shaped, half

as long as the shell. Caudal foot of the same form, twice as long. Two pectoral feet cylindrical, curved, twice as long as the shell, palmate, divided at the distal end into five short fingers.

*Dimensions.*—Shell 0·08 diameter; horns 0·04 long; lateral feet 0·12 long.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

9. *Triceraspyris longicornis*, n. sp.

Shell nut-shaped, papillate, with deep sagittal stricture. Pores irregular roundish. Basal plate with six pores (?). Apical horn short, conical, two frontal horns very large, curved, widely divergent, longer than the shell. Three feet of about the same length, irregularly branched.

*Dimensions.*—Shell 0·08 long, 0·12 broad; lateral horns and feet 0·15 to 0·2 long.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

## Subgenus 3. *Triospyridium*, Haeckel.

*Definition.*—Horns and feet forked or branched.

10. *Triceraspyris damaecornis*, n. sp.

Shell nut-shaped, smooth, compressed, with broad sagittal ring. Pores irregular roundish; one pair of very large pores on each side of the ring. Basal plate with four large collar pores. Three horns and three feet short, divergent, slightly curved, about half as long as the shell, irregularly branched. (In general form very similar to *Elaphospyris damaecornis*, Pl. **84**, fig. 10, with which I formerly confounded it.)

*Dimensions.*—Shell 0·08 long, 0·12 broad; horns and feet 0·04 long.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

11. *Triceraspyris arborescens*, n. sp.

Shell subspherical, with deep sagittal stricture. Pores irregular roundish; three pairs of larger pores on both sides of the ring. Basal plate with two large collar pores. Three horns about half as long as the shell, with few irregular terminal branches. (Beginning of a cupola.) Three feet strong, cylindrical, twice as long as the shell, richly branched, arborescent.

*Dimensions.*—Shell 0·09 long, 0·1 broad; horns 0·05 long, feet 0·2 long.

*Habitat.*—Indian Ocean (Madagascar), Rabbe, surface.

## Genus 443. *Tristylospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with three basal feet, without apical horn.

The genus *Tristylospyris* exhibits in general the same structure as the typical genus *Tripospyris*, its ancestral form. It differs from the latter in the absence of the apical

[1] *Tristylospyris*=Basket with three styles; τρίστυλος, σπυρίς.

horn, which is completely reduced, and may therefore be regarded as the simplest prototype of all tripodal Cyrtellaria without a horn.

Subgenus 1. *Tristylospyrula*, Haeckel.

*Definition.*—Feet simple, not branched nor forked.

1. *Tristylospyris palmipes*, n. sp. (Pl. 84, fig. 14).

Shell companulate, smooth, with slight sagittal stricture. Pores irregular roundish, three pairs of larger annular pores on each side of the broad ring. Basal plate with four large collar pores. Feet half as long as the shell, slightly divergent, straight, prismatic, with a broad, hand-like, radially striped plate at the distal end.

*Dimensions.*—Shell 0·1 long, 0·09 broad; feet 0·06 long.

*Habitat.*—Equatorial Atlantic, Station 347, depth 2250 fathoms.

2. *Tristylospyris scaphipes*, n. sp. (Pl. 84, fig. 13).

Shell nut-shaped, smooth, with sharp sagittal stricture. Pores very small and numerous, circular; two pairs of larger pores on both sides of the ring. Basal plate with four large pores (?). Feet about half as long as the shell, angular, shovel-shaped, straight, parallel, vertical.

*Dimensions.*—Shell 0·06 long, 0·08 broad; feet 0·04 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

3. *Tristylospyris clavipes*, n. sp. (Pl. 84, fig. 15).

Shell nut-shaped, rough, with deep sagittal stricture. Pores small, subregular circular. Basal plate with three large pores. Feet about as long as the shell, slender, straight, divergent, with a spinulate knob at the thickened distal end.

*Dimensions.*—Shell 0·06 long, 0·08 broad; feet 0·05 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

4. *Tristylospyris triceros*, Haeckel.

*Ceratospyris triceros*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xxi. fig. 5.

Shell nut-shaped, tuberculate, without external sagittal stricture. Pores circular, not numerous. Basal plate with four large collar pores. Feet large, cylindrical, three to four times as long as the shell, strongly curved and divergent.

*Dimensions.*—Shell 0·05 long, 0·07 broad; feet 0·15 to 0·2 long.

*Habitat.*—Fossil in Barbados.

Subgenus 2. *Tristylospyrium*, Haeckel.

*Definition.*—Feet forked or branched.

5. *Tristylospyris furcata*, n. sp.

Shell subspherical, rough, with slight sagitta stricture. Pores subregular circular. Basal plate with three large collar pores. Feet cylindrical, three to four times as long as the shell, strongly curved and divergent, at the distal end forked, with two short (sometimes ramified) branches.

*Dimensions.*—Cephalis 0·08 long, 0·09 broad; feet 0·2 to 0·3 long.

*Habitat.*—South Atlantic (off Patagonia), Station 318, surface.

6. *Tristylospyris ramosa*, n. sp. (Pl. 52, fig. 23).

Shell subspherical, tuberculate, with a prominent sagittal ring. Pores irregular roundish. Basal plate with three large pores. Feet large, straight, widely divergent, about twice as long as the shell, prismatic, irregularly branched. (Compare the following species.)

*Dimensions.*—Shell 0·08 in diameter; feet 0·15 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

7. *Tristylospyris tripodiscium*, n. sp. (Pl. 52, fig. 22).

Shell subovate, tuberculate, very similar to the preceding species. It differs from this in the very different size of the irregular pores and the greater breadth of the pedal branches. The basal plate in a complete specimen (observed afterwards from the base) exhibited four large collar pores of the usual form, whilst in the similar preceding species it had three pores. In the similar *Tripodiscium sphærocephalum* (Pl. 52, fig. 21) the basal mouth is quite simple and open.

*Dimensions.*—Shell 0·09 long, 0·1 broad; feet 0·12 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

Genus 444. *Cephalospyris*,[1] Haeckel, 1881, Prodromus, p. 441 (*sensu emend.*).

*Definition.*—Zygospyrida with three basal feet and two large apical openings or coryphal holes, one on each side of the ring-apex. No true horns.

The genus *Cephalospyris* comprises some few Tripospyrida of very peculiar shape, differing from all other Zygospyrida in the possession of two large apical holes or coryphal apertures, lying on each side of a latticed sagittal septum, which is formed by the upper part of the sagittal ring. The sagittal stricture is deep, with a complete

[1] *Cephalospyris* = Head-like basket; κεφαλή, σπυρίς.

primary ring. The vertical axis of the slender ovate shell is much greater than the transverse. The network is very delicate, with very small and numerous triangular or polygonal pores. The central capsule encloses peculiar concrements (Pl. 96, fig. 28).

1. *Cephalospyris cancellata*, n. sp. (Pl. 83, fig. 10).

Shell slender ovate, two and a half times as long as broad, with deep sagittal stricture and complete ring. Network very delicate, with very small and numerous, irregular polygonal pores. The two large apical holes are separated by a latticed triangular sagittal septum, the apex of which represents a rudimentary horn. Basal plate with two large collar holes. Three feet slightly curved, divergent, about half as long as the breadth of the shell; the caudal foot slender, much thinner than the two stout pyramidal pectoral feet.

*Dimensions.*—Shell 0·32 long, 0·13 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Cephalospyris ovata*, n. sp.

Shell slender, ovate, twice as long as broad, with deep sagittal stricture and complete ring. Network very delicate, with very small and numerous triangular pores (on both poles intermingled with irregular polygonal pores). The two large apical holes are separated by a latticed triangular sagittal septum, the upper edge of which is concave and bears two rudimentary horns. Basal plate with four large collar holes. Three feet latticed, slightly curved, convergent, scarcely one-eighth as long as the breadth of the shell. The central capsule filled up by concrements.

*Dimensions.*—Shell 0·32 long, 0·16 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Cephalospyris triangulata*, n. sp. (Pl. 96, fig. 28).

Shell ovate, one and a half times as long as broad, with deep sagittal stricture and complete ring. Network very delicate and regular, with small triangular pores of equal size. The two large apical holes are separated by a latticed semilunar septum, the upper edge of which is concave, and bears two rudimentary horns. Basal plate with three large collar holes (?). Three feet latticed, conical, nearly parallel and vertical (the caudal curved), about half as long as the breadth of the shell. The ovate central capsule contains peculiar amyloidal concentric concrements.

*Dimensions.*—Shell 0·2 long, 0·14 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Subfamily 2. DIPOSPYRIDA, Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida dipoda, with two descending lateral basal feet (probably corresponding to the pectoral feet of *Cortina*).

Genus 445. *Dipospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with two simple free basal feet and one apical horn.

The genus *Dipospyris* and the following five genera represent together the interesting subfamily of Dipospyrida, which always bear two opposite lateral feet only. Therefore in this bipedal group the biradial or bilateral type of the Spyroidea is particularly expressed. Such bipedal forms never occur in the Cyrtoidea. The topographical relation of the two lateral feet to the rods of the collar-plate, and to the cortinar pores separated by these, leaves no doubt that they correspond to the pectoral feet of *Cortina* and *Tripospyris*, and therefore that the Dipospyrida have originated from the Tripospyrida by loss of the caudal foot. *Dipospyris* is the simplest form of the Dipospyrida, with two simple free feet.

1. *Dipospyris bipes*, n. sp.

Shell thorax-shaped, smooth, with deep sagittal stricture, two vaulted bosoms, and subregular circular pores. Basal plate with two large collar pores only. Horn and feet equal, conical, straight, about as long as the shell; the feet widely divergent.

*Dimensions.*—Shell 0·08 long, 0·12 broad; horn and feet 0·1 to 0·15 long.

*Habitat.*—Fossil in Barbados.

2. *Dipospyris mystax*, Haeckel.

*Ceratospyris mystax*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 6.

Shell elliptical spinulate, with slight collar stricture and large subregular circular pores. Basal plate with three pores (?). Horn small conical, oblique, shorter than the shell. Feet slender conical, longer than the shell, slightly curved, divergent. At the base of the columella, between the two feet, a small rudiment of the last caudal foot is visible.

*Dimensions.*—Shell 0·06 long, 0·1 broad; horn 0·02, feet 0·12 long.

*Habitat.*—Fossil in Barbados.

3. *Dipospyris cubus*, n. sp. (Pl. 83, fig. 18).

Shell box-shaped, subcubical, papillate, without external sagittal stricture, with numerous subregular circular pores. Basal plate with three very large collar pores, surrounded by a circle of smaller pores. Apical horn short and thick, scarcely half as long as the shell. Feet of the same form, longer than the shell, widely divergent.

*Dimensions.*—Shell 0·08 long, 0·11 broad; horn 0·03 long, feet 0·14 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

[1] *Dipospyris* = Basket with two feet; δίπους, σπυρίς.

4. *Dipospyris chelifer*, n. sp. (Pl. 85, fig. 3).

Shell elliptical, compressed, nodose, with deep sagittal stricture and irregular roundish pores. Basal plate with three pores (?). Apical horn stout, conical, twice to four times as long as the shell (often much longer than in the figured specimen). Feet scarcely longer than the shell, cylindrical, slightly curved towards one another.

*Dimensions.*—Shell 0·08 long, 0·12 broad; horn 0·2 to 0·3 long, feet 0·1 to 0·15 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

5. *Dipospyris irregularis*, n. sp.

Shell subspherical, without external sagittal stricture, with small circular pores. Basal plate with four pores. Apical horn small, conical, shorter than the shell. Feet three to four times as long as the shell, cylindrical, irregularly curved, very variable in size and form.

*Dimensions.*—Shell 0·08 long, 0·1 broad; horn 0·02 to 0·04 long, feet 0·2 to 0·3 long.

*Habitat.*—Central Pacific, Stations 266 to 268, depth 2700 to 2900 fathoms.

6. *Dipospyris sigmopodium*, n. sp.

Shell violin-shaped, thorny, with deep sagittal stricture and irregular roundish pores. Basal plate with four collar pores. Horn straight, conical, about as long as the shell. Feet twice as long, cylindrical, markedly divergent, S-shaped, curved.

*Dimensions.*—Shell 0·08 long, 0·12 broad; horn 0·06 long, feet 0·2 long.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms; also fossil in Barbados.

7. *Dipospyris forcipata*, n. sp. (Pl. 85, fig. 1).

Shell nut-shaped, tuberculate, with subregular circular pores. Basal plate with four larger and a circle of six to ten smaller pores. Horn cylindrical, straight, two to three times as long as the shell. Feet three to five times as long as the shell, cylindrical, semicircular, with convergent and crossed distal ends. (If these ends grow together, *Gamospyris* arises.)

*Dimensions.*—Shell 0·08 long, 0·11 broad; horn 0·15 to 0·2 long, feet 0·2 to 0·4 long.

*Habitat.*—Central Pacific, Stations 263 to 268, depth 2600 to 3000 fathoms.

Genus 446. *Brachiospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with two simple free basal feet, without apical horn.

The genus *Brachiospyris* differs from the preceding *Dipospyris*, its ancestral form, only in the absence of the reduced apical horn, and therefore bears to it a similar

[1] *Brachiospyris* = Basket with two arms; βραχίων, σπυρίς.

relation to that which the hornless *Tristylospyris*, among the Tripospyrida, bears to the horned *Tripospyris*. *Brachiospyris* may therefore also be derived from *Tristylospyris* by loss of the caudal foot.

1. *Brachiospyris ocellata*, Haeckel.

*Ceratospyris ocellata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 5.

Shell nut-shaped, thorny, with slight sagittal stricture and irregular roundish pores. Basal plate with four large and four alternate pairs of smaller pores. Two feet cylindrical, straight, divergent, two to three times as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·11 broad; feet 0·2 to 0·3 long.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms; also fossil in Barbados.

2. *Brachiospyris diacantha*, n. sp. (Pl. 95, fig. 5).

? *Ceratospyris diacantha*, Ehrenberg, 1872, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 303.

Shell nut-shaped, tuberculate, compressed in the sagittal axis, convex on the frontal face, concave on the sagittal face, with a slight sagittal stricture; with large irregular roundish pores. Basal plate with three very large pores. Two feet cylindrical, curved, S-shaped, about twice as long as the shell.

*Dimensions.*—Shell 0·06 long, 0·09 broad; feet 0·1 to 0·15 long.

*Habitat.*—Western Tropical Pacific (Philippine Sea), Station 206, depth 2100 fathoms.

## Genus 447. *Dendrospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with two free lateral feet, forked or branched like a tree. Apex with a horn.

The genus *Dendrospyris* differs from its ancestral form *Dipospyris* in the ramification of the two large lateral feet, which descend from the base of the shell, and are usually very large and stout, sometimes simply forked.

1. *Dendrospyris stylophora*, Haeckel.

*Ceratospyris stylophora*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 10.

Shell nut-shaped, thorny, with subregular circular pores. Basal plate with four pores. Apical horn and the two divergent feet straight, cylindrical, larger than the shell, forked at the distal end.

[1] *Dendrospyris* = Basket with arborescent feet; δένδρου, σπυρίς.

(The size and number of the fork-branches is variable; the horn is sometimes simple. In some specimens a rudimentary remnant of the lost caudal foot is visible.)

*Dimensions.*—Shell 0·08 long, 0·09 broad; horn and feet 0·1 to 0·12 long.

*Habitat.*—Fossil in Barbados.

2. *Dendrospyris dirrhiza*, Haeckel.

*Ceratospyris dirrhiza*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 9.

Shell nut-shaped, spiny, very similar to the preceding species. It differs from that mainly in the growth of the cylindrical feet, which are not straight and divergent, but more or less curved and convergent; their distal ends are sometimes simply forked, sometimes repeatedly dichotomous. The size and form of the apical horn are also very variable.

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn and feet 0·07 to 0·09 long.

*Habitat.*—Fossil in Barbados.

3. *Dendrospyris bibrachiata*, Haeckel.

*Cladospyris bibrachiata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xxi. fig. 7.

Shell nut-shaped, smooth, with sharp stricture and numerous very small circular pores. Apical horn and the two feet very large and stout, straight, prismatic, with irregular lateral branches on their edges, twice to four times as long as the shell. (The horn in the Ehrenberg's figure is broken off.) This species is closely allied to *Tripospyris tribrachiata*.

*Dimensions.*—Shell 0·05 long, 0·06 broad; horn and feet 0·1 to 0·2 long.

*Habitat.*—Fossil in Barbados.

4. *Dendrospyris furcata*, n. sp.

Shell subspherical, tuberculate, with irregularly roundish pores. Basal plate with two large pores. Apical horn simple, conical, as long as the shell. Feet cylindrical, twice as long, in the proximal half parallel, vertical, in the distal half with two stout divergent equal fork-branches, one of which is directed dorsally, the other ventrally.

*Dimensions.*—Shell 0·07 long, 0·08 broad; horn 0·06 long, feet 0·1 to 0·15 long.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

5. *Dendrospyris polyrrhiza*, n. sp. (Pl. 85, fig. 8).

Shell subspherical, rough, with subregular circular pores. Basal plate with three pores (?). Apical horn simple, conical, half as long as the shell. Feet cylindrical, twice to three times as long as the shell, semicircular, with a strong conical tooth in the middle of their outer convex edge; their distal ends convergent, divided into a bunch of numerous short irregular branches.

*Dimensions.*—Shell 0·7 long, 0·08 broad; horn 0·03 long, feet 0·15 to 0·25 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

6. *Dendrospyris ramosa*, n. sp.

Shell nut-shaped, spiny, with irregular roundish pores. Basal plate with three pairs of pores. Apical horn cylindrical, spinulate, twice to three times as long as the shell. Feet as long as the horn, S-shaped, widely divergent, irregularly branched, with widely distant pointed branches.

*Dimensions.*—Shell 0·08 long, 0·12 broad; horn and feet 0·2 to 0·3 long.

*Habitat.*—North Atlantic, Station 353, depth 2965 fathoms.

7. *Dendrospyris arborescens*, n. sp. (Pl. 85, fig. 9).

Shell nut-shaped, tuberculate, with subregular circular pores. Basal plate with four central larger and ten to twelve peripheral smaller pores. Apical horn cylindrical, twice as long as the shell, in the distal half spinulate or tuberculate. Feet about three times as long as the shell, cylindrical, nearly vertical, in the distal half irregularly branched, with dense bunches of aggregated blunt branches.

*Dimensions.*—Shell 0·07 long, 0·09 broad; horn and feet 0·12 to 0·18 long.

*Habitat.*—Equatorial Atlantic, Station 347, depth 2250 fathoms.

## Genus 448. *Dorcadospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with two free lateral feet armed with a series of secondary spines. Apex with a horn.

The genus *Dorcadospyris* and the closely allied *Stephanospyris* differ from the other Dipospyrida in the development of a series of secondary spines on the convex outer margin of the two large curved lateral feet, which therefore appear semipinnate. In some species this peculiar armature attains an extraordinary size, whilst the shell itself is very small, as in *Dorcadospyris dinoceras* (Pl. 85, fig. 4).

1. *Dorcadospyris dentata*, n. sp. (Pl. 85, fig. 6).

Shell subspherical, tuberculate, with small regular circular pores. Basal plate with four larger pores. Apical horn three to four times as long as the shell, slender, conical, smooth. Feet more or less convexly curved towards one another; the distal ends not crossed. In the convex edge of each arm a series of five to ten smooth conical teeth, not longer than the shell. This common species is very variable and often asymmetrical; the figured specimen is an asymmetrical one, in which the two arms exhibit different curves; in the normal form both arms have the same curve, now more, now less convex.

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn 0·2, feet 0·03 long.

*Habitat.*—Central Pacific, Stations 267 to 274, depth 2350 to 2925 fathoms.

[1] *Dorcadospyris*=Basket with two horns, similar to an antelope; δορκάς, σπυρίς.

2. *Dorcadospyris antilope*, n. sp. (Pl. 85, fig. 5).

Shell subspherical, tuberculate, with small regular circular pores. Basal plate with four larger pores. Apical horn four to six times as long as the shell, straight, cylindrical, smooth. Feet of the same length, crescentic or nearly semicircular, with crossed distal ends. On the convex edge of each foot a series of twelve to fifteen smooth conical teeth, partly longer than the shell. (Very variable in size and curvature of the feet, and number of their teeth.)

*Dimensions.*—Shell 0·09 long, 0·11 broad; horn and feet 0·4 to 0·6 long.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

3. *Dorcadospyris lunulata*, n. sp.

Shell subspherical spinulate, nearly of the same shape as in the preceding species, but with a short conical horn (scarcely as long as the shell); the feet are much more slender, crescentic, and bear twenty to thirty smaller smooth conical teeth (shorter than the shell). The distal ends of the feet are crossed.

*Dimensions.*—Shell 0·08 long, 0·09 broad; horn 0·06 long, feet 0·03 to 0·06 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

4. *Dorcadospyris decussata*, n. sp. (Pl. 85, fig. 7).

Shell subspherical, smooth, very similar to that of the two preceding species. Horn small conical, about as long as the shell. Feet more than semicircular, more strongly curved than in any other species, each with four to eight small conical teeth, shorter than the shell; distal ends crossed. (In this species also, besides the normal symmetrical form, there often occurs an asymmetrical form of the two feet; one of these frequent anomalies is shown in fig. 7.)

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn 0·05, feet 0·2 to 0·5 long.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

5. *Dorcadospyris dinoceras*, n. sp. (Pl. 85, fig. 4).

Shell subspherical, tuberculate, with subregular circular pores. Basal plate with four larger central and eight to twelve smaller peripheral pores. Horn about as long as the shell, in the basal half prismatic, smooth, in the distal half ovate or strobiliform, spiny. Feet very large and strongly curved, together nearly heart-shaped, four to six times as long as the shell. Each foot bears on its outer convex side a series of fifteen to twenty or more strong conical teeth, which are again spinulate, perpendicular to the foot, and longer than the shell.

*Dimensions.*—Shell 0·08 long, 0·09 broad; horn 0·07 long, feet 0·3 to 0·5 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.



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Genus 449. *Gamospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with two simple lateral feet, forming a ring by union.

The genus *Gamospyris* and the similar *Stephanospyris* differ from all other Spyroidea in the possession of a large basal ring, placed in the frontal plane of the shell. This ring has been produced by concrescence of the distal ends of the two large curved lateral feet of *Dipospyris*.

1. *Gamospyris circulus*, n. sp. (Pl. 83, fig. 19).

Shell subspherical, tuberculate, with subregular circular pores. Basal plate with four larger collar pores. Apical horn pyramidal, about as long as the shell. The connected feet form together a circular or nearly circular smooth ring, the diameter of which is three to four times as great as that of the shell.

*Dimensions.*—Shell 0·08 long, 0·09 broad; diameter of the arm-ring 0·25 to 0·33.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Gamospyris annulus*, n. sp.

Shell nut-shaped, tuberculate, with subregular circular pores. Basal plate with four large central and a circle of eight to twelve small peripheral pores. Apical horn conical, twice as long as the shell. The connected arms form together an elliptical smooth ring, which is five times as long and three times as broad as the shell.

*Dimensions.*—Shell 0·07 long, 0·09 broad; ring 0·33 long, 0·26 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

Genus 450. *Stephanospyris*,[2] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Zygospyrida with two lateral feet bearing a series of secondary spines and forming a ring by union.

The genus *Stephanospyris* exhibits the same peculiar armature of the semipinnate lateral feet as its ancestral genus *Dorcadospyris*, but differs from it in the concrescence of the distal ends of the feet, to form a complete foot-ring. The former therefore bears to the latter the same relation that *Gamospyris* does to *Dipospyris*.

1. *Stephanospyris cordata*, n. sp. (Pl. 85, fig. 10).

Shell subspherical, tuberculate, with small regular circular pores. Basal plate with four larger pores. Apical horn cylindrical, three times as long as the shell, with three to four verticils

[1] *Gamospyris* = Basket with two feet grown together; γάμος, σπυρίς.

[2] *Stephanospyris* = Basket with a garland; στέφανος, σπυρίς.

of teeth. The connected feet form a heart-shaped ring, four times as long and three times as broad as the shell. Each foot bears on the outer convex edge four to six stout conical teeth, shorter than the shell. Distal ends crossed and prominent.

*Dimensions.*—Shell diameter 0·1; length of the arm-ring 0·4, breadth 0·3..

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Stephanospyris verticillata*, n. sp. (Pl. 85, fig. 11).

Shell nut-shaped, tuberculate, with subregular circular pores. Basal plate with numerous small pores. Apical horn cylindrical, four to six times as long as the shell, with six to ten verticils of teeth. The connected feet form a circular ring, the diameter of which is four times as great as that of the shell. Each foot bears ten to twelve conical teeth, about as long as the shell. Distal ends not crossed and not prominent.

*Dimensions.*—Diameter of the shell 0·1, of the arm-ring 0·4.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Stephanospyris excellens*, n. sp. (Pl. 83, fig. 20).

Shell subspherical, tuberculate, with regular circular pores. Basal plate with numerous small pores. Apical horn. cylindrical, twice as long as the shell, with eight verticils of teeth. The connected feet form an ovate ring, which is three times as long and two and a half times as broad as the shell. Each foot bears eight conical spinulate teeth, about as long as the shell. The crossed and prominent distal ends bear two parallel vertical teeth.

*Dimensions.*—Diameter of the shell 0·1, of the arm-ring 0·2 to 0·3.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Subfamily 3. TETRASPYRIDA, Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida tetrapoda, with four descending basal feet, two of which are opposite in the sagittal plane (an odd caudal and an odd sternal foot), whilst the two others are paired lateral or pectoral feet.

### Genus 451. *Tetraspyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with four basal feet crossed in pairs (two sagittal and two lateral). Apex with a horn.

The genus *Tetraspyris* and the following closely allied *Tessarospyris* represent together the small subfamily of Tetraspyrida, characterised by the possession of four descending basal feet, three of which correspond to the three original feet of the

[1] *Tetraspyris* = Basket with four feet; τέτρα, σπυρίς.

ancestral genera *Cortina* and *Tripospyris*, whilst the fourth is an odd anterior or sternal foot, produced by anterior prolongation of the basilar segment of the sagittal ring. Here, therefore, two opposed feet lie in the sagittal plane (a caudal and a sternal foot), whilst the two others are the paired lateral or pectoral feet, as also in *Stephanium* and *Stephaniscus*, p. 965. The Tetraspyrida ought not to be confounded with the Therospyrida (sixth subfamily), in which the four feet have another signification.

### Subgenus 1. *Tetrarrhabda*, Haeckel, 1881, p. 429.

*Definition.*—Feet simple, not branched nor forked.

#### 1. *Tetraspyris stephanium*, n. sp. (Pl. 95, fig. 6).

Shell nut-shaped, tuberculate, with deep sagittal stricture and small roundish pores; three pairs of larger pores on each side of the ring. Basal plate with four large collar pores. Apical horn stout conical, half as long as the shell. Two pectoral feet somewhat longer than the two sagittal feet, one and a half times as long as the shell. All four feet straight, three-sided prismatic, strongly divergent.

*Dimensions.*—Shell 0·08 long, 0·12 broad; horn 0·04 long, feet 0·08 to 0·12 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

#### 2. *Tetraspyris cubica*, n. sp.

Shell nearly cubical, smooth, with slight sagittal stricture and small polygonal pores; some larger pores on both sides of the ring. Basal plate with four large collar pores. Apical horn and the four feet of equal size and form, about as long as the shell, cylindrical in the basal, spindle shaped in the distal half.

*Dimensions.*—Shell 0·09 diameter; horn and feet 0·1 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; also fossil in Barbados.

### Subgenus 2. *Tetracorethra*, Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Feet branched or forked.

#### 3. *Tetraspyris tetracorethra*, n. sp. (Pl. 53, figs. 19, 20).

*Tetracorethra mirabilis*, Haeckel, 1881, Prodromus, p. 429, and Atlas, *loc. cit.*

Shell campanulate, tuberculate, with deep sagittal stricture and irregular polygonal pores; two pairs of larger pores at the flattened occipital face (fig. 20). Basal plate with four large collar pores. Apical horn very long, thirty to forty times as long as the shell, slender three-sided prismatic, straight, at the distal end irregularly branched, besom-shaped. Four basal feet half as

thick as the horn, eight to twelve times as long as the shell, bristle-shaped, irregularly curved and branched, divergent, at the distal end besom-shaped. Central capsule very large; the enclosed small campanulate part sends out through the four collar pores four very long club-shaped basal lobes, half as long as the feet; each lobe contains a large oil-globule (fig. 19).

*Dimensions.*—Shell 0·036 diameter; horn 1 to 1·5 mm. long, feet 0·3 to 0·4 long.

*Habitat.*—Central Pacific, Station 270, surface.

4. *Tetraspyris calcarata*, n. sp.

Shell campanulate, smooth, very similar to that of the preceding species, but differing in the following characters:—the two inferior occipital pores are four times (in the preceding twice) as large as the two superior; the apical horn bears at its distal end only three simple branches; the sternal foot is smaller than the three others, arises higher, is more divergent and curved, and bears at its base a large horizontal conical spur.

*Dimensions.*—Shell 0·035 diameter; horn 1 to 1·2 long, feet 0·2 to 0·3 long.

*Habitat.*—Central Pacific, Station 266, surface.

5. *Tetraspyris scoparia*, n. sp.

Shell campanulate, rough, very similar to the two preceding species, but differing in the following characters:—the four occipital pores are of nearly equal size; the apical horn is simple, not branched; the four feet are forked near the base, so that apparently eight feet diverge, each in the distal half richly branched, besom-shaped.

*Dimensions.*—Shell 0·038 diameter; horn 1 to 1·1 long, feet 0·4 to 0·5 long.

*Habitat.*—Central Pacific, Station 268, surface.

## Genus 452. *Tessarospyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with four basal feet crossed in pairs (two sagittal and two lateral). Apex without horn.

The genus *Tessarospyris* differs from the preceding *Tetraspyris*, its ancestral genus, in the absence of the apical horn, and therefore bears to it the same relation that *Tristylospyris* does to *Tripospyris*.

1. *Tessarospyris clathrobursa*, n. sp. (Pl. 53, fig. 8).

*Clathrobursa dictyopus*, Haeckel, 1881, Prodromus, p. 429, and Atlas, pl. liii. fig. 8.

Shell nearly ovate, strongly compressed, smooth, one and a half times as long as broad, with deep sagittal stricture in the basal half. Pores very small and numerous, irregularly roundish. Basal plate with four very large triangular holes, two larger (posterior) cardinal, and two smaller (anterior)

[1] *Tessarospyris*=Basket with four feet; τέσσαρα, σπυρίς.

jugular pores; above the latter (on the frontal face) two large mental pores. Two pectoral feet large, half as long as the shell, at the base fenestrated, vertical, and parallel. Two sagittal feet much smaller, nearly horizontal, pyramidal (the caudal larger than the sternal foot). Two longitudinal pectoral ribs arise on the frontal face.

*Dimensions.*—Shell 0·21 long, 0·14 broad; lateral feet 0·1, sagittal feet 0·02.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

2. *Tessarospyris nuciformis*, n. sp.

Shell nut-shaped, papillate, with deep sagittal stricture. Pores irregular roundish, on both sides of the ring three to six times as large as on the lateral sides. Basal plate with four large pores. Two pectoral feet cylindrical curved, twice as long as the shell and as the two sagittal feet; the caudal is much stronger than the sternal foot.

*Dimensions.*—Shell 0·06 long, 0·09 broad; lateral feet 0·1, sagittal feet 0·05 long.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

3. *Tessarospyris seminulum*, Haeckel.

*Petalospyris seminulum*, Stöhr, 1880, Palæontogr., vol. xxvi. pl. iii. fig. 12.

Shell subspherical, smooth, with slight sagittal stricture and small circular pores; some larger pores on both sides of the ring. Basal plate with two large (lateral) pores only. Four feet nearly equal, short, conical, divergent, scarcely one-fourth as long as the shell.

*Dimensions.*—Shell 0·06 long, 0·08 broad; feet 0·016 long.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte), Stöhr.

## Subfamily 4. Hexaspyrida, Haeckel.

*Definition.*—Zygospyrida hexapoda, with six descending basal feet; three of these are primary (one odd caudal and two paired pectoral feet), the other three are secondary, opposed diametrically to the former and alternating with them (one odd sternal and two paired tergal feet).

### Genus 453. *Hexaspyris*,[1] n. gen.

*Definition.*—Zygospyrida with six basal feet and one apical horn.

The genus *Hexaspyris* and the two following closely allied genera represent together the peculiar subfamily of Hexaspyrida, and differ from the other Zygospyrida in the possession of six descending basal feet; three of these are the three original, perradial, or primary basal feet of *Cortina*, *Cortiniscus*, *Plagoniscus*, *Plectaniscus*, *Tripospyris*, &c.; the other three, usually opposed to the former diametrically, are

[1] *Hexaspyris*=Basket with six feet; ἑξά, σπυρίς.

secondary or interradial; an odd sternal foot (opposed to the odd caudal) and two paired tergal feet (opposed to the two paired pectoral).

### Subgenus 1. *Hexaspyridium*, Haeckel.

*Definition.*—Feet simple, not branched nor forked.

#### 1. *Hexaspyris alterna*, n. sp.

Shell nut-shaped, smooth, with deep sagittal stricture and irregular polygonal pores; on each side of the stricture two pairs of larger square annular pores. Basal plate also with four larger collar pores. Apical horn twice as long as the shell, conical. Three primary feet (the apical and the two pectoral) slender, curved, as long as the horn; three secondary feet (the sternal and the two tergal) are half as long as the former and more highly inserted; all six feet strongly divergent, cylindrical, pointed.

*Dimensions.*—Shell 0·06 long, 0·09 broad; horn 0·15 long, feet 0·08 to 0·14 long.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

#### 2. *Hexaspyris setigera*, Haeckel.

*Ceratospyris setigera*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 11.

*Ceratospyris setigera*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 539, Taf. xxxii. figs. 11*a*, 11*b*.

Shell nut-shaped, tuberculate, with a complete internal sagittal ring and numerous small circular pores. Basal plate with four larger central and a circle of twelve to twenty smaller peripheral pores. Apical horn half as long as the shell, bristle-shaped. Three primary feet longer and more deeply inserted than the three secondary feet; all six feet strongly divergent, bristle-shaped, shorter than the shell.

*Dimensions.*—Shell 0·06 long, 0·09 broad; horn 0·03 long; primary feet 0·05, secondary 0·02 long.

*Habitat.*—Fossil in Barbados.

#### 3. *Hexaspyris bütschlii*, Haeckel.

*Ceratospyris triomma*, Bütschli (*non* Ehrenberg), 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 539, Taf. xxxii. fig. 12, *a*, *b*.

Shell nut-shaped, spinulate, with a complete internal sagittal ring and subregular circular pores. Basal plate with twelve pores (four larger central and eight smaller peripheral). Apical horn stout, oblique, as long as the shell. Six feet of equal length, slightly divergent, nearly vertical, slender three to four times as long as the shell.

*Dimensions.*—Shell 0·05 long, 0·07 broad; horn 0·06, feet 0·15 to 0·2 long.

*Habitat.*—Fossil in Barbados.

4. *Hexaspyris spinosa*, Haeckel.

*Petalospyris spinosa*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 98, Taf. iii. fig. 14.

Shell subspherical, smooth, with slight sagittal stricture and irregular polygonal pores; on each side of the stricture two pairs of larger pores. Basal plate with two large pores only. Apical horn short, pyramidal, three primary feet half as long as the shell and twice as long as the three secondary feet. All six feet pyramidal, slightly divergent.

*Dimensions.*—Shell 0·05 long, 0·07 broad; horn 0·02, feet 0·02 to 0·04 long.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte, Caltanisetta).

5. *Hexaspyris ophirensis*, Haeckel.

*Petalospyris ophirensis*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. ix. fig. 24.

Shell nut-shaped, with deep sagittal stricture and numerous irregular roundish pores; two pairs of larger pores on each side of the stricture. Apical horn short, curved. Six feet equal, divergent, straight, slender, about as long as the shell.

*Dimensions.*—Shell 0·05 long, 0·1 broad; horn 0·01, feet 0·05 to 0·08 long.

*Habitat.*—Indian Ocean (Zanzibar), depth 2200 fathoms, Pullen.

## Subgenus 2. *Hexacorethra*, Haeckel.

*Definition.*—Feet forked or branched.

6. *Hexaspyris hexacorethra*, n. sp. (Pl. 95, fig. 8).

*Hexacorethra magica*, Haeckel, 1882, Manuscript.

Shell campanulate, smooth, with sharp sagittal stricture and irregular roundish pores. Basal plate with six larger collar pores. Apical horn very long and thin, three-sided prismatic, straight, ten to twenty times as long as the shell, branched at the distal end. Six feet thinner, bristle-shaped, six to eight times as long as the shell, divergent, irregularly curved, in the distal part branched, besom-shaped; the sternal foot at its base with a large conical horizontal spur.

*Dimensions.*—Shell 0·034 diameter; horn 0·4 to 0·8 long, feet 0·2 to 0·3 long.

*Habitat.*—Central Pacific, Station 265, surface.

7. *Hexaspyris articulata*, Haeckel.

*Ceratospyris articulata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 4.

Shell nut-shaped, tuberculate, with deep sagittal stricture and small irregular roundish pores. Basal plate with six pores (?). Apical horn conical, longer than the shell. Six feet very large, thick

cylindrical, divergent, three to four times as long as the shell, with few irregular lateral branches (often much more developed than in Ehrenberg's figure).

*Dimensions.*—Shell 0·036 long, 0·05 broad; horn 0·05, feet 0·1 to 0·15 long.

*Habitat.*—Fossil in Barbados.

Genus 454. *Liriospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Zygospyrida with six basal feet and three coryphal horns.

The genus *Liriospyris* differs from the preceding *Hexaspyris*, its ancestral form, in the possession of three coryphal horns (one odd apical in the middle, and two paired frontal horns on each side of it); it therefore bears to the latter the same relation that *Triceraspyris* does to *Tripospyris*.

1. *Liriospyris hexapoda*, n. sp. (Pl. 86, fig. 7).

Shell subspherical, smooth, with slight sagittal stricture and irregular roundish pores; two to three pairs of large annular pores on each side of the stricture. Basal plate with four large collar pores. Three horns and six feet nearly of the same size and of similar form, conical, divergent, about one-third as long as the shell.

*Dimensions.*—Shell diameter 0·09 to 0·1; horns and feet 0·03 to 0·04 long.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

2. *Liriospyris clathrata*, Haeckel.

*Dictyospyris clathrus*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 25.

*Dictyospyris clathrata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xix. fig. 7.

*Dictyospyris clathrata*, Bütschli, 1882, Zeitschr. f. Wiss. Zool., vol. xxxvi. pp. 506, 539; Taf. xxxii. figs. 10*a*, 10*b*.

*Petalospyris clathrus*, Haeckel, 1862, Monogr. d. Radiol., p. 295.

Shell campanulate or nearly spherical, smooth, with slight sagittal stricture. Three pairs of large annular pores on each side of the stricture; a few smaller irregular pores on the lateral sides. Basal plate with six large collar pores (Bütschli, *loc. cit.*, fig. 10*a*). Three horns and six feet nearly of the same size and form; short, conical, slightly divergent or nearly parallel, shorter than half the ring. (The size of the nine appendages is in this common species rather variable; sometimes they are rudimentary, at other times much stronger than in the good figure of Bütschli.)

*Dimensions.*—Shell diameter 0·08 to 0·09, horns and feet 0·01 to 0·03.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific; also fossil in Barbados and Sicily.

[1] *Liriospyris* = Lily-basket; λείριον, σπυρίς.

3. *Liriospyris heteropoda*, n. sp.

Shell nut-shaped, nodose, with deep sagittal stricture and small circular pores; two pairs of larger pores on each side of the stricture. Basal plate with four larger central and eight smaller peripheral pores. Apical horn conical, as long as the shell and twice as long as the two curved frontal horns. Three primary feet twice as long as the shell and as the three secondary feet, which are more highly inserted. All six feet slender curved, divergent.

*Dimensions.*—Shell 0·07 long, 0·11 broad; horn and secondary feet 0·08 long, primary feet 0·15 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

4. *Liriospyris turrita*, Haeckel.

*Ceratospyris turrita*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 1.

Shell ovate, campanulate, smooth, with sharp sagittal stricture and irregular roundish pores; three to four pairs of larger pores on each side of the stricture. Basal plate with four large collar pores. Three horns short and stout, conical, fenestrated at the base. Six feet slender, conical, nearly vertical, of equal size, only one-third as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·06 broad; horns 0·01 long, feet 0·03 long.

*Habitat.*—Fossil in Barbados.

5. *Liriospyris amphithecta*, n. sp. (Pl. 95, fig. 7).

Shell nut-shaped, tuberculate, with distinct sagittal stricture and irregular roundish pores. Basal plate with six larger and twelve smaller pores. Three horns conical, the apical as long as the shell and twice as long as the curved frontal horns. Two pectoral feet cylindrical, very large, curved, divergent, about three times as long as the shell and as the four other feet, which are conical.

*Dimensions.*—Shell 0·08 long, 0·12 broad; apical horn 0·08, frontal horns 0·05 long; length of the two pectoral feet 0·2, of the four others 0·06.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Genus 455. *Cantharospyris*,[1] n. gen.

*Definition.*—Zygospyrida with six basal feet, without apical horn.

The genus *Cantharospyris* differs from the preceding two hexapodal genera in the absence of horns on the coryphal face, and has therefore the same relation to them that the hornless *Tristylospyris* bears to the one-horned *Tripospyris* and the three-horned *Triceraspyris*.

[1] *Cantharospyris* = Basket with six feet, like a beetle; κάνθαρος, σπυρίς.

1. *Cantharospyris carabus*, n. sp.

Shell nut-shaped, with deep sagittal stricture and irregular roundish pores. Basal plate with six larger pores. Six feet of different sizes, cylindrical, curved; three primary feet (one caudal and two pectoral) about as long as the shell and twice as long as the three secondary feet.

*Dimensions.*—Shell 0·08 long, 0·12 broad; feet 0·05 to 0·09 long.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms; Central Pacific, Station 268, depth 2900 fathoms.

2. *Cantharospyris ateuchus*, Haeckel.

*Ceratospyris ateuchus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xxi. fig. 4.

Shell nut-shaped, tuberculate, with slight sagittal stricture and unequal circular pores. Basal plate with six larger pores. The two pectoral feet very large and stout, four to six times as long as the shell, widely divergent, curved. The four other feet much smaller and thinner, about as long as the shell.

*Dimensions.*—Shell 0·06 long, 0·08 broad; length of the two larger feet 0·2 to 0·3, of the four smaller 0·05 to 0·07.

*Habitat.*—Fossil in Barbados.

3. *Cantharospyris radicata*, Haeckel.

*Ceratospyris radicata*, Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 43; Mikrogeol., 1854, Taf. xxii. fig. 37.
*Haliomma radicatum*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 83.
*Petalospyris radicata*, Haeckel, 1862, Monogr. d. Radiol., p. 295.
*Petalospyris radicata*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 79, Taf. iii. fig. 11.

Shell nut-shaped, smooth, with slight sagittal stricture and irregular roundish pores; two larger pores on each side of the ring. Basal plate with six pores (?). Six feet of equal size and similar form, conical, divergent, slightly curved, shorter than half the ring.

*Dimensions.*—Shell 0·05 long, 0·08 broad; feet 0·02 long.

*Habitat.*—Fossil in Barbados and Sicily.

4. *Cantharospyris platybursa*, n. sp. (Pl. 53, fig. 7).

*Platybursa compressa*, Haeckel, 1881, Prodromus, p. 429; Atlas, pl. 53, fig. 7.

Shell smooth, nearly discoidal circular, markedly compressed in the sagittal direction, with slight basal stricture. Pores very numerous, irregular polygonal, with thin bars. Basal plate with four very large pores. Six feet short, conical, nearly horizontally expanded. Two sagittal feet (caudal

and sternal) larger, about half as long as the shell (shortened in the figure). The two sternal feet larger than the two small or rudimentary tergal feet.

*Dimensions.*—Shell 0·15 long, 0·13 broad; feet 0·02 to 0·06 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Subfamily 5. PENTASPYRIDA, Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida pentapoda, with five descending basal feet, one odd caudal foot, and two pairs of lateral feet (two anterior or pectoral, and two posterior or tergal feet).

### Genus 456. *Clathrospyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with five basal feet and one apical horn.

The genus *Clathrospyris* and the two following closely allied genera represent together the small subfamily of Pentaspyrida, differing from the other Zygospyrida in the possession of five descending feet on the basal face. Three of these are the primary cortinar feet (of *Cortiniscus*, *Plagoniscus*, *Tripospyris*, &c.), whilst the two others are secondary tergal feet. The Pentaspyrida may therefore be probably derived from the Hexaspyrida by loss of the odd anterior or sternal foot.

#### 1. *Clathrospyris camelopardalis*, n. sp.

Shell nut-shaped, tuberculate, with deep sagittal stricture. Pores irregular roundish. Basal plate with six pores (?). Two pectoral feet very large, twice as long as the shell, cylindrical, curved. Two tergal feet half as long and thick as the pectoral. Caudal foot and apical horn straight, conical, half as long as the shell.

*Dimensions.*—Shell 0·07 long, 0·09 broad; horn and odd caudal foot 0·04 long; pectoral feet 0·16, tergal 0·08 long.

*Habitat.*—South Pacific, Station 297, depth 1775 fathoms.

#### 2. *Clathrospyris pyramidalis*, n. sp. (Pl. 95, fig. 9).

Shell four-sided pyramidal, truncate, thorny, with slight sagittal stricture. Pores very large, polygonal roundish. Two pairs of large pores on each side of the ring (at the frontal and the occipital plate). Lateral pores more numerous. Basal plate with four large pores. The four edges of the pyramid are prolonged into four short pyramidal divergent lateral feet (one-third as

[1] *Clathrospyris* = Latticed basket; κλῆθρον, σπυρίς.

long as the shell). Caudal foot short. Horn at the apex of the truncate pyramid with two lateral teeth.

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn and feet 0·02 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 3. *Clathrospyris fusiformis*, n. sp.

Shell nearly cubical, smooth, with slight sagittal stricture. Pores roundish; three pairs of larger pores on each side of the ring. Basal plate with six large pores. Five feet of equal length, slender, spindle-shaped, about as long as the shell, divergent. Apical horn conical, and half as long as the feet.

*Dimensions.*—Shell 0·08 long, 0·09 broad; horn 0·05 long, feet 0·1 long.

*Habitat.*—Fossil in Barbados.

## Genus 457. *Aegospyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with five basal feet and three coryphal horns.

The genus *Aegospyris* differs from the preceding *Clathrospyris*, its ancestral form, in the possession of three horns on the coryphal face (one odd apical, and two paired frontal horns on each side), and therefore bears to the latter the same relation that *Triceraspyris* does to *Tripospyris*, and *Liriospyris* to *Hexaspyris*.

### 1. *Aegospyris aequispina*, n. sp.

Shell nut-shaped, tuberculate, with slight sagittal stricture. Pores subregular circular. Basal plate with four large collar pores. Three horns and five feet all of equal size and similar form, slender conical, slightly curved, widely divergent, about as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·11 broad; horns and feet 0·08 long.

*Habitat.*—Central Pacific, Stations 265 to 274, depth 2350 to 2925 fathoms.

### 2. *Aegospyris octospina*, n. sp.

Shell nearly cubical, smooth, with slight sagittal stricture. Pores subregular circular; two pairs of larger pores on each side of the ring. Basal plate with four large pores. Two paired horns and four paired feet of equal size and similar form, S-shaped curved, twice as long as the shell. Odd horn and odd feet half as long, straight, conical.

*Dimensions.*—Shell 0·08 long, 0·09 broad; six paired spines 0·2 long, two odd spines 0·1 long.

*Habitat.*—South Atlantic, Station 323, depth 1900 fathoms.

[1] *Aegospyris* = Goat-basket; ἀιγοσπυρίς.

3. *Aegospyris longibarba*, Haeckel.

*Ceratospyris longibarba*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xxi. figs. 1, 2.

Shell nut-shaped, tuberculate, with slight sagittal stricture. Pores subregular circular. Basal plate with four larger central, and eight smaller peripheral pores. Apical horn and caudal foot short, straight, conical; two frontal horns longer, curved; four paired feet slender, curved, twice as long as the shell.

*Dimensions.*—Shell 0·06 long, 0·08 broad; paired horns 0·03 long, paired feet 0·1 long.

*Habitat.*—Fossil in Barbados.

4. *Aegospyris aegoceras*, n. sp. (Pl. 95, fig. 10).

Shell nut-shaped, tuberculate, with deep sagittal stricture. Pores irregular roundish. Basal plate with three large pores. Apical horn and caudal foot short, straight, spindle-shaped; two frontal horns as long as the shell, strongly curved; four paired feet also curved, at the distal end forked, divergent; the tergal thinner and as long as the shell, the pectoral thicker and twice as long.

*Dimensions.*—Shell 0·07 long, 0·09 broad; pectoral feet 0·1 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

5. *Aegospyris caprina*, n. sp. (Pl. 86, fig. 8).

Shell nut-shaped, papillate, with sharp sagittal stricture. Pores irregular roundish, two pairs of larger pores on each side of the ring. Basal plate with six large pores. Eight spines all straight, subvertical and nearly parallel, cylindro-conical. Two frontal horns and two tergal feet about as long as the shell; odd horn shorter; odd foot longer. Two pectoral feet twice as long as the shell, club-shaped, with a spinulate knob at the distal end.

*Dimensions.*—Shell 0·06 long, 0·09 broad; pectoral feet 0·11 long.

*Habitat.*—Central Pacific, Station 271, surface.

## Genus 458. *Pentaspyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with five basal feet, without apical horn.

The genus *Pentaspyris* differs from the two preceding genera in the absence of any coryphal horn, and represents therefore the pentapodal form among the hornless Zygospyrida.

1. *Pentaspyris pentacantha*, n. sp. (Pl. 95, fig. 11).

Shell nut-shaped, tuberculate, with deep sagittal stricture. Pores irregular roundish, two pairs of larger pores on each side of the ring. Basal plate with four larger pores. All five feet cylin-

[1] *Pentaspyris* = Basket with five feet; πέντε, σπυρίς.

drical, S-shaped curved, strongly divergent, with few short branches, the two pectoral feet twice as long as the shell and the two tergal feet; odd caudal foot shorter.

*Dimensions.*—Shell 0·08 long, 0·13 broad; pectoral feet 0·2 long, tergal feet 0·1, caudal foot 0·06.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Pentaspyris isacantha*, n. sp.

Shell subspherical, smooth, with slight sagittal stricture. Pores small, regular circular. Basal plate with six large pores (?). All five feet equal, cylindrical, C-shaped curved, slightly divergent, about as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·09 broad; feet 0·07 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Subfamily 6. THEROSPYRIDA, Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida tetrapoda with two pairs of descending basal feet, one pair corresponding to the anterior or pectoral, the other pair to the posterior or tergal feet of the Hexaspyrida.

### Genus 459. *Zygospyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with two pairs of lateral feet and an apical horn.

The genus *Zygospyris* and the following three genera represent together the peculiar subfamily of Therospyrida. These always possess four basal feet, like the Tetraspyrida; but whilst in the latter group two feet are sagittal, and two lateral, in the Therospyrida there are no sagittal feet at all, but the four feet are opposed in two lateral pairs; the anterior pair corresponds to the pectoral, the posterior to the tergal feet of the Hexaspyrida and Pentaspyrida; from these latter the Therospyrida have been derived by loss of the sagittal feet.

1. *Zygospyris quadrupes*, n. sp.

Shell nut-shaped, tuberculate, with deep sagittal stricture. Pores irregular roundish, on each side of the ring two pairs of larger pores. Apical horn conical, straight. Four feet equal, straight, divergent, conical, about as long as the shell and the horn.

*Dimensions.*—Shell 0·08 long, 0·11 broad; horn and feet 0·1 long.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

[1] *Zygospyris* = Bilocular basket, with paired halves; ζυγά, σπυρίς.

2. *Zygospyris equus*, n. sp. (Pl. 83, fig. 16).

Shell subspherical, rough, with slight sagittal stricture. Pores small and numerous, subregular circular; no larger annular pores. Apical horn cylindrical, half as long as the shell. Two pectoral feet somewhat smaller than the two tergal feet, about as long as the shell, slightly divergent, cylindrical. The distal ends of the feet and of the horn form an ovate, dimpled and spinulate cone.

*Dimensions.*—Shell 0·06 long, 0·09 broad; horn 0·04 long, feet 0·06 long.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Genus 460. *Elaphospyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with two pairs of lateral feet and three coryphal horns.

The genus *Elaphospyris* differs from the preceding *Zygospyris*, its ancestral form, in the possession of three coryphal horns (one odd apical and two paired frontal horns), and therefore bears to it the same relation that *Triceraspyris* does to *Tripospyris* among the Tripospyrida.

### Subgenus 1. *Giraffospyris*, Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Feet simple, not branched nor forked.

1. *Elaphospyris heptaceros*, Haeckel.

*Ceratospyris heptaceros*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 2.

*Giraffospyris heptaceros*, Haeckel, 1881, Prodromus, p. 442.

Shell nut-shaped, tuberculate, with slight sagittal stricture and subregular circular pores. Basal plate with four large pores. Apical horn small conical, shorter than the two curved lateral horns, which are as long as the shell. Caudal and sternal feet small, conical, straight. Two pectoral feet slender, divergent, S-shaped, about as long as the shell.

*Dimensions.*—Shell 0·05 long, 0·07 broad; horns and feet 0·02 to 0·008 long.

*Habitat.*—Fossil in Barbados.

2. *Elaphospyris capricornis*, n. sp.

Shell nut-shaped, spiny, with slight sagittal stricture and numerous small circular pores. Basal plate with four large pores. Three horns slender, simple, about as long as the shell, the middle one straight, the two lateral curved. Four feet of nearly equal size, slender, curved, divergent, simple, twice as long as the shell and the horns.

*Dimensions.*—Shell 0·07 long, 0·09 broad; horns 0·08 long, feet 0·15 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

[1] *Elaphospyris* = Deer-basket; ἔλαφος, σπυρίς.

Subgenus 2. *Corythospyris*, Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Feet branched or forked.

3. *Elaphospyris damaecornis*, n. sp. (Pl. 84, fig. 10).

Shell flat and broad, nearly triangular, with slight sagittal stricture and irregular roundish pores; two very large pores on the frontal and on the occipital face, opposite on both edges of the broad sagittal ring. Basal plate with four large central and several smaller lateral pores. Three horns about half as long as the shell, with two to six irregular branches. Four feet of equal size, about as long as the shell, divergent, forked, with four to six irregular terminal branches. (The shell in fig. 10 is seen from the apical side.)

*Dimensions.*—Shell 0·09 long, 0·13 broad; horns 0·05 long, feet 0·1 long.

*Habitat.*—Indian Ocean, Cocos Islands, Rabbe, surface.

4. *Elaphospyris cervicornis*, n. sp. (Pl. 86, fig. 13).

Shell polyhedral, spiny, with deep sagittal stricture and a small number of large roundish pores; two pairs of large pores on each side of the ring. Basal plate with four pores. Three large horns as long as the shell arise from the apex between smaller conical spines; the middle odd horn simple, the two lateral each with a pair of branches. Two pectoral feet very large, divergent, with broad and irregular distal ramification, twice as long as the shell and as the two tergal feet, which are less branched. (Fig. 13 exhibits the shell from the dorsal side.)

*Dimensions.*—Shell 0·09 long, 0·11 broad; horns and smaller feet 0·07 to 0·09 long; pectoral feet 0·16 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

5. *Elaphospyris alcicornis*, n. sp. (Pl. 86, fig. 12).

Shell nut-shaped, spiny, with sharp sagittal stricture and large roundish pentagonally framed pores; three pairs of larger pores on each side of the ring. Basal plate with four larger and four alternate smaller pores. There arise from the apex, between smaller spines, three large, divergent, pyramidal horns, which are nearly as long as the shell, and connected by an arched frontal bridge. Two pectoral feet very large, divergent, prismatic, longer than the shell, and at the distal end with a bunch of thick spines. Two tergal feet half as long and thick, simple (in the figure hidden behind the large pectoral feet).

*Dimensions.*—Shell 0·09 long, 0·11 broad; horns and smaller feet 0·06 long, pectoral feet 0·12 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

Genus 461. *Taurospyris*,[1] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with two pairs of lateral feet and one pair of lateral horns.

The genus *Taurospyris* bears only two frontal horns in the coryphal face of the shell, and may therefore be derived from the preceding closely allied *Elaphospyris* by reduction and loss of the middle or apical horn.

1. *Taurospyris cervina*, n. sp. (Pl. 95, fig. 12).

Shell nut-shaped, thorny, with deep sagittal stricture and irregular roundish pores; three pairs of larger pores on each side of the ring. Basal plate with four large pores. Two horns cylindrical, curved, widely divergent, about as long as the shell, branched. Four feet of nearly equal length, also cylindrical and curved, divergent, somewhat longer than the shell, in the distal half branched like a deer's antler.

*Dimensions.*—Shell 0·07 long, 0·11 broad; horns 0·03 long, feet 0·06 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms; also fossil in Barbados.

2. *Taurospyris bovina*, n. sp.

Shell subspherical, smooth, with slight sagittal stricture and small circular pores. Basal plate with six larger pores. Two horns conical, curved, divergent, about as long as the shell. Two pectoral feet very large, twice as long as the shell and as the two thinner tergal feet; all four feet curved, cylindrical, divergent, pointed at the distal end.

*Dimensions.*—Shell 0·08 long, 0·09 broad; horns and posterior feet 0·1, anterior feet 0·2 long.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

Genus 462. *Therospyris*,[2] Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida with two pairs of lateral feet, without apical horn.

The genus *Therospyris* has two pairs of lateral feet corresponding to those of the preceding three genera, but differs from them in the complete absence of horns on the coryphal face of the shell.

1. *Therospyris canis*, n. sp.

Shell nut-shaped, tuberculate, with deep sagittal stricture. Pores irregular, roundish. Basal plate with four longer pores. Surface covered with roundish tubercles. Four feet equal, divergent, about as long as the shell, thickened at the distal end, club-shaped, not forked.

*Dimensions.*—Shell 0·07 long, 0·11 broad; feet 0·09 long.

*Habitat.*—Fossil in Barbados.

[1] *Taurospyris*=Bull-basket; ταῦρος, σπυρίς.

[2] *Therospyris*=Basket with four feet, like a beast; θήρ, σπυρίς.

2. *Therospyris felis*, n. sp. (Pl. 89, fig. 6).

Shell nut-shaped, mammillate, with sharp sagittal stricture. Pores large, irregularly roundish or polygonal, of somewhat different size. Basal plate with four large pores. Surface covered with hemispherical pointed mammillæ. Four feet equal, divergent, half as long as the shell, at the distal end forked, with few small branches.

*Dimensions.*—Shell 0·1 long, 0·15 broad; feet 0·05 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Therospyris leo*, n. sp. (Pl. 89, fig. 5).

Shell nearly cubical, papillate, with slight sagittal stricture. Pores irregular, roundish; on each side of the ring three pairs of larger pores (the undermost the largest). Basal plate with two large pores. Surface covered with conical papillæ. Four feet equal, divergent, about as long as the shell, with an external spur in the middle, and irregularly branched spines at the distal end.

*Dimensions.*—Shell 0·08 long, 0·12 broad; feet 0·09 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Subfamily 7. POLYSPYRIDA, Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Zygospyrida polypoda, with numerous descending basal feet (at least seven to nine, usually twelve to sixteen or more).

### Genus 463. *Petalospyris*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Zygospyrida with numerous (seven to twelve or more) basal feet and one apical horn.

The genus *Petalospyris* and the following three genera form together the peculiar subfamily of Polyspyrida, differing from the other Zygospyrida in the multiplication of the radial feet, which descend from the basal face of the shell; they may therefore be also called "Zygospyrida multiradiata," and bear the closest relationship to the Archiphænida (or the "Monocyrtida multiradiata"). They differ, however, from the latter in the presence of the distinct sagittal stricture, characteristic of all Spyroidea. The number of the basal feet, which form a coronet around the margin of the basal plate, is commonly between twelve and sixteen, but often more. Their form is usually flat, lamellar, but often also more or less cylindrical or conical.

[1] *Petalospyris* = Leaf-basket; πέταλος, σπυρίς.

## Subgenus 1. *Petalospyrantha*, Haeckel.

*Definition.*—Basal plate with two large collar pores only, separated by the base of the primary ring.

### 1. *Petalospyris foveolata*, Ehrenberg.

*Petalospyris foveolata*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 14; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 80, Taf. xxii. fig. 10.

Shell campanulate, smooth, with distinct sagittal stricture and subregular circular pores. Basal plate with two large collar pores only. Apical horn and the eight feet slender, conical, slightly curved, about as long as the shell; feet somewhat divergent (often seven or nine instead of eight).

*Dimensions.*—Shell diameter 0·04 to 0·05; length of the horn and the feet 0·04 to 0·05.

*Habitat.*—Fossil in Barbados.

### 2. *Petalospyris floscula*, n. sp.

Shell nut-shaped, tuberculate, with deep sagittal stricture and subregular circular pores. Basal plate with two large triangular pores only. Apical horn slender, conical, twice as long as the shell. Twelve to sixteen feet flattened, leaf-shaped, broad, slightly divergent, as long as the shell, with truncate distal end.

*Dimensions.*—Shell 0·06 long, 0·09 broad; horn 0·12 long, feet 0·05 to 0·07 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Subgenus 2. *Petalospyrella*, Haeckel.

*Definition.*—Basal plate with three large collar pores (two paired posterior cardinal, and an odd anterior sternal pore).

### 3. *Petalospyris triomma*, n. sp. (Pl. 87, fig. 14).

Shell nut-shaped, tuberculate, with sharp sagittal stricture and irregular roundish pores. Basal plate with three large pores and three alternate smaller. Apical horn stout, conical, half as long as the shell. Twelve to fifteen feet, divergent, curved, pointed, as long as the horn.

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn and feet 0·03 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 4. *Petalospyris platyacantha*, Ehrenberg.

*Petalospyris platyacantha*, Ehrenberg, Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 80, Taf. xxii. fig. 8.

Shell campanulate, smooth, with slight sagittal stricture and small irregular roundish pores. Basal plate with three large pores (?). Apical horn very strong, three-sided pyramidal, twice as

long as the shell (its edge is described by Ehrenberg as a "canaliculus.") Feet ten to twelve, flat, triangular, vertical, about as long as the shell.

*Dimensions.*—Shell 0·04 long, 0·05 broad; horn 0·07 long, feet 0·03 long.

*Habitat.*—Fossil in Barbados.

### 5. *Petalospyris corona*, Stöhr.

*Petalospyris corona*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 98, Taf. iii. fig. 13.

Shell nut-shaped, smooth, with slight sagittal stricture and very numerous small circular pores; on each side of the stricture three larger annular pores (the undermost the largest). Basal plate with three large pores only. Apical horn very small, conical. Feet twelve to eighteen, short conical, nearly vertical, shorter than the half shell (in my specimen from Caltanisetta much stouter than in that of Stöhr).

*Dimensions.*—Shell 0·07 long, 0·09 broad; horn and feet 0·01 to 0·03 long.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte, Caltanisetta).

## Subgenus 3. *Petalospyrissa*, Haeckel.

*Definition.*—Basal plate with four collar pores (two larger posterior cardinal and two smaller anterior jugular pores).

### 6. *Petalospyris octopus*, n. sp. (Pl. 87, fig 11).

Shell nut-shaped, tuberculate, with sharp sagittal stricture and irregular, roundish pores. Basal plate with four larger pores. Horn slender, conical, half as long as the shell. Feet eight, very slender, about three times as long as the shell, subvertical, with outer convex edge and convergent ends.

*Dimensions.*—Shell 0·06 long, 0·09 broad; horn 0·03 long, feet 0·2 long.

*Habitat.*—Tropical Atlantic, Station 342, depth 1445 fathoms.

### 7. *Petalospyris eupetala*, Ehrenberg.

*Petalospyris eupetala*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xxii. fig. 4.

Shell nut-shaped, tuberculate, with slight sagittal stricture and scattered small circular pores. Basal plate with four large collar pores (sometimes surrounded by several small peripheral pores). Apical horn slender, conical, as long as the shell. Feet sixteen to twenty, laminated and truncate, of the same length, nearly vertical and parallel.

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn and feet 0·05 to 0·07 long.

*Habitat.*—Fossil in Barbados.

8. *Petalospyris anthemis*, n. sp.

Shell nut-shaped, spinulate, with deep sagittal stricture and irregular, roundish pores. Basal plate with four large pores of equal size. Apical horn conical, twice as long as the shell. Feet twenty to thirty, laminated and truncate, as long as the shell, divergent.

*Dimensions.*—Shell 0·05 long, 0·08 broad; horn 0·1 long, feet 0·6 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

9. *Petalospyris tessaromma*, n. sp.

Shell subspherical, with slight sagittal stricture and few small pores; on each side of the stricture four larger, square, annular pores. Basal plate with four large collar pores (two larger cardinal and two smaller jugular pores). Horn and feet conical, about half as long as the shell. Feet twenty to twenty-five, slightly curved, convergent.

*Dimensions.*—Shell diameter 0·08; horn and feet 0·04.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

## Subgenus 4. *Petalospyromma*, Haeckel.

*Definition.*—Basal plate with numerous (six or more) collar pores, commonly three or four larger central, and six to twelve smaller peripheral pores.

10. *Petalospyris novena*, n. sp. (Pl. 83, fig. 12).

Shell nut-shaped, tuberculate, with slight sagittal stricture and irregular, roundish pores. Basal plate with nine pores (three large primary and three alternate pairs of small secondary pores). Nine long corresponding feet, twice to four times as long as the shell (three very thick primary, and three alternate pairs of thin secondary feet). All feet cylindrical, curved, widely divergent. Horn conical.

*Dimensions.*—Shell 0·06 long, 0·08 broad; horn and feet 0·15 to 0·25.

*Habitat.*—Indian Ocean (Cocos Islands), Rabbe, surface.

11. *Petalospyris argiscus*, Ehrenberg.

*Petalospyris argiscus*, Ehrenberg, 1875, Abhandl. d. k. Akad. Wiss. Berlin, p. 80, Taf. xxii. figs. 1, 2.

*Petalospyris argiscus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 539, Taf. xxxii. fig. 17, *a*, *b*.

Shell nut-shaped, tuberculate, with slight sagittal stricture and irregular, roundish pores. Basal plate with nine pores (three larger central and three alternate pairs of smaller peripheral pores).

Apical horn slender, spindle-shaped, about as long as the shell. Twenty to twenty-five feet, of the same length, broad, lamellar and truncate, nearly vertical, slightly divergent.

*Dimensions.*—Shell 0·06 long, 0·1 broad; horn and feet 0·05 to 0·07 long.

*Habitat.*—Fossil in Barbados.

### 12. *Petalospyris papillata*, n. sp.

Shell nearly cubical, papillate, without external sagittal stricture, with small, irregular, roundish pores. Basal plate with six pores (three larger and three alternate smaller). Apical horn conical, half as long as the shell. Feet twenty to thirty, one-half to one-third as long, conical, divergent.

*Dimensions.*—Shell diameter 0·09; horn 0·04 long, feet 0·03 to 0·05 long.

*Habitat.*—North Atlantic, Station 353, depth 2965 fathoms.

### 13. *Petalospyris dictyocubus*, n. sp. (Pl. 86, fig. 6).

Shell nearly cubical, smooth, without external stricture, but with a complete, parietal, square, sagittal ring. On each side of the ring four pairs of larger pores, whilst the lateral pores are smaller and more numerous. Basal plate also with four pairs of larger pores and smaller lateral pores. Apical horn and basal feet short, pyramidal, scarcely one-fourth as long as the shell. The three primary feet are larger than the six to nine secondary feet.

*Dimensions.*—Shell diameter 0·08; horn and feet 0·02 long.

*Habitat.*—Central Pacific, Station 274, surface.

### 14. *Petalospyris bellidiastrum*, n. sp.

Shell nut-shaped, tuberculate, with slight sagittal stricture and irregular, roundish pores. Basal plate with twelve pores (four central larger and eight peripheral smaller pores). Apical horn slender, conical, about as long as the shell (sometimes ramified at the distal end). Feet sixteen to twenty, broadly lamellar, truncate, divergent, about as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·1 broad; horn and feet 0·07 to 0·09 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; also fossil in Barbados.

### 15. *Petalospyris dinoceras*, n. sp. (Pl. 87, fig. 12).

Shell nut-shaped, mammillate, without external stricture, but with complete external sagittal ring. Pores subregular, circular. Basal plate with four large central pores, surrounded by a circle of twelve to twenty small peripheral pores. Apical horn very large, spindle-shaped, one and a half times as long as the shell. Feet twenty-five to thirty, broadly lamellar, truncate, divergent, about as long as the shell.

*Dimensions.*—Shell 0·11 long, 0·13 broad; horn 0·15 long, feet 0·09 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

16. *Petalospyris furcata*, n. sp.

Shell nut-shaped, smooth, with sharp sagittal stricture. Pores numerous, small, and circular; no larger annular pores. Basal plate with four larger and four alternate pairs of smaller pores. Horn conical, about as long as the shell. Feet fifteen to twenty, broadly lamellar, about twice as long as the shell, in the distal half forked.

*Dimensions.*—Shell 0·04 long, 0·06 broad; horn 0·05 long, feet 0·1 long.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

17. *Petalospyris lobata*, n. sp. (Pl. 87, fig. 13).

Shell subspherical, smooth, with slight sagittal stricture. Pores small, roundish; on each side of the ring two pairs of larger annular pores. Basal plate with four pores. Horn stout, three-sided prismatic, half as long as the shell. Feet twelve to sixteen, lamellar, lobate (the most part with three lobes), nearly vertical, about as long as the shell.

*Dimensions.*—Shell diameter 0·05; horn 0·03, feet 0·05 long.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

## Genus 464. *Anthospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Zygospyrida with numerous (seven to nine or more) basal feet and three coryphal horns.

The genus *Anthospyris* differs from the preceding *Petalospyris*, its ancestral form, in the possession of three horns on the coryphal face (one odd middle apical horn and two paired frontal horns, one on each side). The former therefore bears to the latter the same relation that *Triceraspyris* does to *Tripospyris* and *Liriospyris* to *Hexaspyris*.

1. *Anthospyris mammillata*, n. sp. (Pl. 87, fig. 16).

Shell nut-shaped, mammillate, with deep sagittal stricture and irregular, polygonal pores. Basal plate with two large ovate pores (?). The pediculate apical horn and the two frontal horns stout and short, conical, twice to three times as large as the conical papillæ of the surface. Feet twelve to fifteen, lanceolate lamellar, pointed, divergent, about as long as the shell.

*Dimensions.*—Shell 0·05 long, 0·08 broad; horns 0·03, feet 0·04 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

[1] *Anthospyris* = Flower-basket; ἄνθος, σπυρίς.

2. *Anthospyris spathulata*, n. sp. (Pl. 87, fig. 15).

Shell subspherical, thorny, with slight sagittal stricture and irregular, roundish pores. Basal plate with three large pores. The three horns spindle-shaped, half as long as the ten to twelve thin feet, which are pediculate, shovel-shaped, a little divergent, and shorter than the shell.

*Dimensions.*—Shell 0·05 diameter; horn 0·02 long, feet 0·04 long.

*Habitat.*—North Pacific, Station 250, depth 3050 fathoms.

3. *Anthospyris diaboliscus*, Haeckel.

*Petalospyris diaboliscus*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 12; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 80, Taf. xxii. fig. 3.

Shell nut-shaped, smooth, with slight sagittal stricture and small circular pores. Basal plate with four large pores. Apical horn straight conical, frontal horns curved laterally. Feet nine to twelve, of about the same length as the horns and the shell, broad lamelliform, truncate, nearly vertical, slightly curved.

*Dimensions.*—Shell 0·04 long, 0·07 broad; horns and feet 0·05 to 0·07 long.

*Habitat.*—Fossil in Barbados.

4. *Anthospyris arachnoides*, Haeckel.

*Petalospyris arachnoides*, Haeckel, 1862, Monogr. d. Radiol., p. 294, Taf. xii. fig. 7.

Shell nut-shaped, tuberculate, with slight sagittal stricture and irregular, polygonal pores. Basal plate with four large pores (?). Apical horn straight, conical, longer than the two curved lateral horns. Feet ten, slender, S-shaped, widely divergent; about as long as the shell is broad.

*Dimensions.*—Shell 0·05 long, 0·08 broad; horns 0·03 to 0·05 long, feet 0·08 long.

*Habitat.*—Mediterranean (Messina), Atlantic, Station 354, surface.

5. *Anthospyris aculeata*, n. sp. (Pl. 86, fig. 5).

Shell campanulate, spiny, with deep sagittal stricture and irregular, roundish pores. On each side of the stricture three pairs of larger annular pores. Basal plate with two large square pores. The three horns of the same size as, and similar form to, the ten to fifteen feet, slender pyramidal, straight, divergent, about half as long as the shell. (This species is very variable and closely allied to *Ceratospyris.*)

*Dimensions.*—Shell diameter 0·08 to 0·12; horns and feet 0·04 to 0·06 long.

*Habitat.*—Central Pacific, Stations 266 to 274, surface.

6. *Anthospyris doronicum*, n. sp. (Pl. 87, fig. 18).

Shell nut-shaped, spiny, with a deep sagittal stricture and small circular pores. On each side of the stricture two pairs of very large square annular pores. Basal plate with four larger collar

pores and a corona of numerous small peripheral pores. Three horns spindle-shaped, divergent, about half as long as the shell. Feet twenty-five to thirty, broad, lamellar, lanceolate, pointed divergent, nearly as long as the shell.

*Dimensions.*—Shell 0·1 long, 0·13 broad; horns 0·06, feet 0·09 long.

*Habitat.*—South Pacific, Station 296, depth 1825 fathoms.

### 7. *Anthospyris tragopogon*, n. sp. (Pl. 87, fig. 17).

Shell nut-shaped, tuberculate, with distinct sagittal stricture and small regular circular pores. Basal plate with numerous small pores. Apical horn very large, spindle-shaped, twice as long as the shell; frontal horns small, scarcely one-fourth as long, curved laterally. Feet twenty-five to thirty, three to four times as long as the shell, lamellar, lanceolate, pointed, parallel, vertical.

*Dimensions.*—Shell 0·08 long, 0·11 broad; apical horn 0·16, feet 0·2 long.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

## Genus 465. *Ceratospyris*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Zygospyrida with numerous (seven to twelve or more) basal feet and numerous coryphal horns.

The genus *Ceratospyris* differs from all the other Zygospyrida in the possession of numerous large spines on the surface of the shell, which usually exhibits only a small number of large pores or meshes. The lower spines which cover the inferior or basal face of the shell (usually nine to twelve or more) may be compared to the descending "basal feet" of the other Zygospyrida; the upper spines, however, which cover the superior or coryphal face (usually six to nine, rarely more), may be regarded as "coryphal horns." In many species of this genus the lattice-work of the shell is of a peculiar loose kind, with few large meshes, resembling the wicker-work of the Plectanida.

### Subgenus 1. *Lophospyris*, Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Spines simple, not branched. Meshes of the shell usually polygonal, or roundish with polygonal frames. Bars of the network prismatic.

### 1. *Ceratospyris polygona*, n. sp. (Pl. 86, fig. 1).

Shell polyhedral, with deep sagittal stricture, studded with twenty-four to thirty long simple straight slender pyramidal spines, which are as long as the shell or longer. All pores large, polygonal. On the frontal and the occipital face two pairs of very large pores only, the superior

[1] *Ceratospyris* = Horned basket; κέρας, σπυρίς.

pentagonal, larger than the inferior tetragonal. Basal plate with two triangular pores. Bars of the loose framework three-sided prismatic, thin.

*Dimensions.*—Shell 0·08 long, 0·12 broad; spines 0·06 to 0·12 long.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, surface.

### 2. *Ceratospyris pentagona*, Ehrenberg.

*Ceratospyris pentagona*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. x. fig. 15.

Shell polyhedral, with slight sagittal stricture, studded with twenty-four to thirty small simple conical spines, which are shorter than one-fourth of the shell. Most pores pentagonal. On the frontal and the occipital face two pairs of large pores only, the superior smaller than the inferior. Basal plate with four quadrangular pores. Bars of the network prismatic, thin.

*Dimensions.*—Shell 0·07 long, 0·11 broad; spines 0·01 to 0·02 long.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, surface.

### 3. *Ceratospyris allmersii*, n. sp. (Pl. 86, fig. 3).

Shell polyhedral, with slight sagittal stricture, studded with thirty to forty prismatic spines which are not longer than half the shell. Most pores pentagonal. On the frontal face two, on the occipital three pairs of larger pores; the inferior the largest. Basal plate with two rhomboidal pores (?). Bars of the network three-sided prismatic, thin. Dedicated to my dear friend, the excellent poet and naturalist, Hermann Allmers, of Rechtenfleth.

*Dimensions.*—Shell 0·08 long, 0·12 broad; spines 0·01 to 0·03.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

### 4. *Ceratospyris mulderi*, n. sp. (Pl. 86, fig. 4).

Shell polyhedral, with deep sagittal stricture, studded with fifty to seventy prismatic spines; two inferior (pectoral) spines about as long as the shell, the others much shorter. Pores polygonal. On the frontal and the occipital face one pair of very large pores. Basal plate with two distinctly hexagonal pores. Bars of the loose network prismatic. Dedicated to my dear friend, the excellent author and painter, Ludwig Mulder, of the Hague.

*Dimensions.*—Shell 0·07 long, 0·12 broad; spines 0·01 to 0·08.

*Habitat.*—Indian Ocean, Sunda Straits (Rabbe), surface.

### 5. *Ceratospyris strasburgeri*, n. sp. (Pl. 86, fig. 2).

Shell polyhedral, with slight sagittal stricture, studded with thirty to forty prismatic spines, which are about half as long as the shell (two or four inferior are longer). Pores roundish, with polygonal frames. On the frontal and occipital face two pairs of larger pores (the superior

smaller). Basal plate with two large pentagonal pores. Bars of the network prismatic. Dedicated to my dear friend, the celebrated botanist, Professor Eduard Strasburger, of Bonn.

*Dimensions.*—Shell 0·07 long, 0·1 broad; spines 0·02 to 0·04.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475.

### 6. *Ceratospyris müllleri*, Stöhr.

*Ceratospyris müllleri*, Stöhr, 1880, Palæontogr., vol. xxvi. Taf. iii. fig. 15.

Shell polyhedral, with slight collar stricture, studded with forty to fifty pyramidal spines, shorter than half the shell. Pores circular, with pentagonal frames of the same breadth, all nearly of equal size. (Basal plate with four pores?) Bars of the network prismatic. Dedicated to Johannes Müller.

*Dimensions.*—Shell 0·08 long, 0·1 broad; spines 0·01 to 0·03.

*Habitat.*—Fossil in Tertiary rocks of Sicily, Grotte (Stöhr).

### 7. *Ceratospyris krausei*, n. sp. (Pl. 86, fig. 10).

Shell nut-shaped, with deep sagittal stricture, studded with forty to fifty strong conical spines; six basal spines as long as the shell and two to three times as long as the others. Pores roundish polygonal, twice to three times as broad as the bars; two pairs of larger pores on each side of the ring. (Basal plate with four large pores?) Bars of the network rounded, thick. Dedicated to my dear friend, the excellent author, Ernst Krause (Carus Sterne), of Berlin.

*Dimensions.*—Shell 0·06 long, 0·09 broad; spines 0·03 to 0·08.

*Habitat.*—Western Tropical Pacific (Philippine Sea), Station 206, depth 2100 fathoms.

### 8. *Ceratospyris preyeri*, n. sp. (Pl. 86, fig. 9).

Shell nut-shaped, with slight sagittal stricture, studded with ten to twelve longer club-shaped spines (about as long as the shell) and numerous smaller conical spines. Pores irregular, roundish, numerous; two pairs of larger pores on each side of the ring. Basal plate with four large pores. Bars of the network rounded. Dedicated to my honoured friend and colleague, the celebrated investigator of psychical ontogeny, Professor William Preyer, of Jena.

*Dimensions.*—Shell 0·07 long, 0·09 broad; spines 0·02 to 0·08 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 9. *Ceratospyris echinus*, Ehrenberg.

*Ceratospyris echinus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 12.

Shell subspherical, with slight sagittal stricture, studded with numerous conical curved spines; six basal and one apical spine are larger than the others, about as long as the shell. Pores numerous, small, circular. Basal plate with numerous pores. Bars of the network roundish.

*Dimensions.*—Shell 0·05 long, 0·06 broad; spines 0·02 to 0·05 long.

*Habitat.*—Fossil in Barbados.

Subgenus 2. *Cladospyris*, Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Spines forked or branched. Meshes roundish or polygonal.

10. *Ceratospyris ramosa*, Ehrenberg.

*Ceratopyris ramosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xx. fig. 7.
*Cladospyris ramosa*, Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

Shell nut-shaped, with slight sagittal stricture, studded with numerous conical, irregularly branched spines. The largest about as long as the shell. Pores irregular, roundish; on each side of the ring two pairs of larger pores. Basal plate with four pores. Bars of the network roundish.

*Dimensions.*—Shell 0·06 long, 0·08 broad; spines 0·02 to 0·08 long.

*Habitat.*—Fossil in Barbados.

11. *Ceratospyris carnerii*, n. sp. (Pl. 86, fig. 11).

Shell nut-shaped, with sharp sagittal stricture, studded with numerous pyramidal spines; two basal spines are larger, as long as the shell, and irregularly branched. Pores polygonal; on each side of the ring three pairs of larger pores. Basal plate with four large pores. Dedicated to my dear friend, the excellent monistic philosopher, B. von Carneri.

*Dimensions.*—Shell 0·09 long, 0·12 broad; spines 0·02 to 0·08 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

12. *Ceratospyris calorrhiza*, n. sp. (Pl. 87, fig. 19).

Shell nut-shaped, with deep sagittal stricture, studded with numerous conical strong spines, about one-fourth as long as the shell. Basal spines irregularly branched, with root-like ends. Pores irregular, roundish, some larger pores on each side of the ring. Basal plate with four larger pores. Bars of the network roundish.

*Dimensions.*—Shell 0·1 long, 0·14 broad; spines 0·02 to 0·04 long.

*Habitat.*—Central Pacific, Station 271, surface.

Genus 466. *Gorgospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Zygospyrida with numerous (seven to twelve or more) basal feet, without coryphal horns.

The genus *Gorgospyris* agrees with the three preceding genera in the possession of numerous basal feet, but differs from them in the complete absence of any horns on the coryphal face. It represents therefore the "hornless polypedal Zygospyrida,' and may

[1] *Gorgospyris* = Medusiform basket; γοργώ, σπυρίς.

be derived from *Petalospyris* by loss of the original apical horn. The feet are commonly numerous, and often form a circle around the margin of the basal plate, similar to the circle of tentacles in many Medusæ (Gorgon).

### Subgenus 1. *Gorgospyrium*, Haeckel.

*Definition.*—Feet simple, not branched.

1. *Gorgospyris medusa*, n. sp. (Pl. 87, fig. 1).

Shell hemispherical, papillate, with slight sagittal stricture and subregular circular pores. Basal plate with three large collar pores (by mistake not correctly represented in the figure). Ten to twelve slender feet, twice as long as the shell, strongly curved and divergent, of equal length.

*Dimensions.*—Shell 0·06 long, 0·08 broad; feet 0·1 long.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

2. *Gorgospyris medusetta*, n. sp. (Pl. 87, fig. 2).

Shell nut-shaped, smooth, with deep sagittal stricture and irregular, roundish pores. Basal plate with three large collar pores, alternating with three pairs of smaller pores. Sixteen to twenty slender feet, about as long as the shell, slightly curved and divergent, of nearly equal length.

*Dimensions.*—Shell 0·05 long, 0·08 broad; feet 0·05 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

3. *Gorgospyris ehrenbergii*, Haeckel.

*Petalospyris pentas*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xxii. fig. 11.

Shell nut-shaped, smooth, with slight sagittal stricture and unequal circular pores. Basal plate with three large central pores, alternating with three pairs of smaller pores, and with a peripheral circle of smaller pores. Twenty-four to thirty short truncated feet, shorter than half the shell.

*Dimensions.*—Shell 0·05 long, 0·07 broad; feet 0·02 long.

*Habitat.*—Fossil in Barbados.

4. *Gorgospyris polypus*, n. sp. (Pl. 87, fig. 3).

Shell hemispherical, papillate, with slight sagittal stricture and subregular circular pores. Basal plate with four larger and four alternating smaller pores. Feet sixteen to twenty, slender, curved, divergent; four primary feet larger, twice to three times as long as the shell and the other feet.

*Dimensions.*—Shell 0·08 long, 0·1 broad; feet 0·1 to 0·2 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

5. *Gorgospyris eurycolpos*, n. sp. (Pl. 87, fig. 5).

Shell nut-shaped, rough, with deep sagittal stricture and irregular, roundish pores; two to three pairs of larger annular pores on each side of the stricture. Basal plate with four large collar pores. Feet eight, short, triangular, vertical, about one-fourth as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·13 broad; feet 0·02 long.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

6. *Gorgospyris liriope*, n. sp. (Pl. 87, fig. 6).

Shell nut-shaped, thorny, with sharp sagittal stricture and irregular, roundish pores. Two pairs of larger annular pores on each side of the ring. Basal plate with two very large circular pores only. Eight to ten short feet vertical, about one-fourth as long as the shell, with an elegant papillate knob at the distal end.

*Dimensions.*—Shell 0·07 long, 0·1 broad; feet 0·02 long.

*Habitat.*—South Atlantic, Station 323, depth 1900 fathoms.

7. *Gorgospyris lamellosa*, n. sp.

Shell nut-shaped, tuberculate, with subregular circular pores. Basal plate with four larger and four alternate pairs of smaller pores. Feet fifteen to twenty-five, broad, lamellar, vertical, truncate, about as long as the shell, of irregular size and form, very variable.

*Dimensions.*—Shell 0·07 long, 0·1 broad; feet 0·05 to 0·1 long.

*Habitat.*—Fossil in Barbados.

Subgenus 2. *Thamnospyris*, Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Feet divided or branched.

8. *Gorgospyris schizopodia*, n. sp. (Pl. 87, fig. 4).

Shell hemispherical, smooth, with slight sagittal stricture and small regular, circular pores. Basal plate with four large central and a circle of small pores. Feet fifteen to twenty, broad, lamellar, confluent at the base, about as long as the shell, irregularly divided or forked.

*Dimensions.*—Shell 0·06 long, 0·08 broad; feet 0·05 to 0·08 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

9. *Gorgospyris thamnopodia*, n. sp.

*Thamnospyris thamnopodia*, Haeckel, 1881, Prodromus, p. 443.

Shell nut-shaped, tuberculate, with deep sagittal stricture and irregular, roundish pores. Basal plate with numerous small pores. Feet twenty to thirty, slender, curved, divergent, twice to three times as long as the shell, irregularly branched.

*Dimensions.*—Shell 0·08 long, 0·12 broad; feet 0·15 to 0·25 long.

*Habitat.*—Indian Ocean (Madagascar), Rabbe, surface.

Subfamily 8. CIRCOSPYRIDA, Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Zygospyrida apoda, without descending basal feet.

Genus 467. *Circospyris*,[1] Haeckel, 1881, Prodromus, p. 444.

*Definition.*—Zygospyrida without basal feet, with an apical horn.

The genus *Circospyris* and the following closely allied genus *Dictyospyris* represent together the small subfamily Circospyrida, differing from all other Zygospyrida in the absence of feet on the basal face. They have probably arisen from the Tripospyrida (*Tripospyris*) by reduction and loss of the feet (in the same way as the eradiate Cyrtoidea from the triradiate). But it is also possible that many of the Circospyrida (if not all) are derived directly from the Semantida (*Clathrocircus*) by the closing of the two lateral openings and by completing the framework.

1. *Circospyris nucula*, n. sp. (Pl. 95, fig. 13).

Shell nut-shaped, compressed, smooth, with prominent sagittal ring. On each side of the ring three to four pairs of very large annular polygonal pores. Lateral pores small and numerous, roundish. Basal plate with two large pores only. Horn slender, conical, shorter than half the shell.

*Dimensions.*—Shell 0·11 long, 0·13 broad.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

2. *Circospyris gigas*, Haeckel.

*Dictyospyris gigas*, Ehrenberg, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xix. fig. 6.

Shell nut-shaped, tuberculate, with distinct sagittal stricture. On each side of the ring four pairs of larger annular pores. Lateral pores roundish, smaller. Basal plate with four large central and a circle of eight to twelve smaller peripheral pores. Horn cylindrical, about half as long as the shell (in the inverted figure of Ehrenberg directed downwards).

*Dimensions.*—Shell 0·1 to 0·15 long, 0·15 to 0·2 broad; horn 0·05 to 0·08 long.

*Habitat.*—Fossil in Barbados.

3. *Circospyris tridentata*, Haeckel.

*Dictyospyris tridentata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xix. fig. 10, *a*, *b*.

Shell nut-shaped, smooth, with sharp sagittal stricture. On each side of the ring two pairs of large annular pores. Lateral pores roundish, smaller. Basal plate with six large pores. Horn slender, cylindrical, about as long as the shell, with three sharp teeth at the distal end.

*Dimensions.*—Shell 0·03 long, 0·05 broad; horn 0·03 long.

*Habitat.*—Fossil in Barbados.

[1] *Circospyris* = Basket with a ring; *κίρκος*, *σπυρίς*.

Genus 468. *Dictyospyris*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Zygospyrida without basal feet, and without coryphal horns.

The genus *Dictyospyris*, the last and simplest of the twenty-eight genera of Zygocyrtida, may be regarded either as a primordial ancestral form of this large family, or more probably as the last and most reduced form of it. In the former case the total absence of coryphal horns and basal feet is primary, in the latter case secondary, effected by phylogenetic reduction and loss. But it is also possible that in one part of the numerous species of this genus the former case, and in another the latter takes place, and that one part of *Dictyospyris* may be directly developed from the Semantida or Coronida (the lattice shell becoming complete), another part arising from the Tripospyrida or Dipospyrida (the horns and feet becoming lost).

Subgenus 1. *Dictyospyrantha*, Haeckel.

*Definition.*—Basal plate with two large pores only (the primary jugular pores of *Semantis*).

1. *Dictyospyris distoma*, n. sp. (Pl. 89, figs. 11, 12).

Shell nut-shaped, smooth, or somewhat tuberculate, with deep sagittal stricture. Pores not numerous, large, roundish-polygonal; three pairs of large annular pores on each side of the ring. Basal plate with two very large pentagonal roundish collar pores.

*Dimensions.*—Shell 0·06 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

2. *Dictyospyris stalactites*, n. sp. (Pl. 89, fig. 7).

Shell nut-shaped, covered with irregular ramified tubercles (like stalactites), with deep sagittal stricture. Pores not numerous, large, irregular, roundish. Two pairs of large triangular pores on each side of the ring (the inferior larger). Basal plate with two very large semicircular collar pores.

*Dimensions.*—Shell 0·07 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms; also fossil in Barbados.

[1] *Dictyospyris* = Net-basket; δίκτυον, σπυρίς.

3. *Dictyospyris biloba*, n. sp.

Shell subspherical, tuberculate, with slight sagittal stricture. Pores very numerous, small, circular. No larger pores on either side of the ring. Basal plate with two very large circular pores, surrounded by a circle of smaller pores.

*Dimensions.*—Shell 0·07 long, 0·08 broad.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

## Subgenus 2. *Dictyospyrella*, Haeckel.

*Definition.*—Basal plate with three large collar pores (two paired posterior cardinal pores and an odd anterior sternal pore).

4. *Dictyospyris triomma*, n. sp.

Shell nut-shaped, smooth, with deep sagittal stricture. Pores not numerous, large, polygonal roundish, two pairs of very large annular pores on each side of the ring. Basal plate with three large triangular pores. No free internal procolumella.

*Dimensions.*—Shell 0·06 long, 0·09 broad.

*Habitat.*—Indian Ocean, Zanzibar (Pullen), depth 2200 fathoms.

5. *Dictyospyris tristoma*, Ehrenberg.

*Dictyospyris tristoma*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xix. fig. 9.

Shell nut-shaped, tuberculate, with slight sagittal stricture. Pores numerous, irregular, roundish. Three pairs of larger annular pores on each side of the ring. Basal plate with three large semicircular pores (the sternal odd pore apparently halved by an internal free procolumella).

*Dimensions.*—Shell 0·05 long, 0·08 broad.

*Habitat.*—Fossil in Barbados and Sicily (Caltanisetta).

6. *Dictyospyris triloba*, Ehrenberg.

*Dictyospyris triloba*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xix. fig. 8.

Shell nut-shaped, spinulate, without external stricture, but with a complete internal sagittal ring. Pores numerous, subregular circular; no larger annular pores. Basal plate with three large, heart-shaped two-lobed collar pores.

*Dimensions.*—Shell 0·05 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

7. *Dictyospyris gigas*, Bütschli.

*Dictyospyris gigas*, Bütschli, 1880, Zeitschr. f. wiss. Zool., vol. xxxvi., p. 539, Taf. xxxii. fig. 14*a*, 14*b*.

Shell subspherical, smooth, with a half (ventral) sagittal stricture, and a nearly complete internal ring. Pores very numerous and small, circular. No larger annular pores. Basal plate with three large collar pores (the sternal odd pore apparently divided into two jugular pores by the visible free procolumella. (Compare *Circospyris gigas*, p. 1072 = *Dictyospyris gigas*, Ehrenberg).

*Dimensions.*—Shell 0·1 long, 0·14 broad.

*Habitat.*—Fossil in Barbados.

Subgenus 3. *Dictyospyrissa*, Haeckel.

*Definition.*—Basal plate with four large collar pores (two larger posterior cardinal and two smaller anterior jugular pores).

8. *Dictyospyris fenestra*, Ehrenberg.

*Dictyospyris fenestra*, Ehrenberg, 1875, Abhandl. d.k. Akad. d. Wiss. Berlin, p. 68, Taf. xix. fig. 11.

Shell nearly cubical, smooth, without external sagittal stricture. Internal sagittal ring complete. Pores small, roundish; on each side of the ring two crossed pairs of large, square, equal, annular pores. Basal plate also with four longer pores of nearly equal size.

*Dimensions.*—Shell 0·05 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

9. *Dictyospyris tetrastoma*, Ehrenberg.

*Dictyospyris tetrastoma*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xix. fig. 12.

Shell nut-shaped, tuberculate, with slight sagittal stricture. Pores numerous, irregular, roundish. No larger annular pores. Basal plate with four large ovate collar pores (the two cardinal twice as large as the two jugular pores).

*Dimensions.*—Shell 0·05 long, 0·07 broad.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific; also fossil in Barbados and Sicily.

10. *Dictyospyris spinulosa*, Ehrenberg.

*Dictyospyris spinulosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xix. fig. 13.

? *Ceratospyris borealis*, Bailey, 1856, Amer. Journ. of Science and Arts, vol. xxii. pl. i. fig. 3.

Shell nut-shaped, spinulate, without external stricture, with an internal free sagittal ring. Pores numerous, irregular, roundish; on each side of the ring two pairs of very large square pores. Basal plate with four large collar pores.

*Dimensions.*—Shell 0·07 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms; also fossil in Barbados.

### 11. *Dictyospyris mammillaris*, n. sp. (Pl. 89, figs. 9, 10).

Shell mammillate, nut-shaped, with deep sagittal stricture. Mammillæ of the surface hemispherical, with a conical apex. Pores not numerous, large, roundish. Two pairs of large pores on each side of the ring. Basal plate with four large pores.

*Dimensions.*—Shell 0·06 long, 0·08 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 12. *Dictyospyris anthophora*, n. sp. (Pl. 89, fig. 8).

Shell tuberculate, nut-shaped, nearly cubical, without external sagittal strictures. Pores not numerous, large, polygonally roundish. Bars between them compressed, elevated, with large, campanulate or flower-like tubercles on the nodal points. Basal plate with four large pores.

*Dimensions.*—Shell 0·07 long, 0·09 broad.

*Habitat.*—North Atlantic, Station 349, depth 2450 fathoms.

### 13. *Dictyospyris quadriloba*, n. sp.

Shell nut-shaped, smooth, with deep sagittal stricture. Pores numerous, small, circular, on each side of the ring three to four times as large as on the lateral sides. Basal plate with four very large collar pores and a circle of twenty to twenty-five very small peripheral pores.

*Dimensions.*—Shell 0·08 long, 0·11 broad.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

### 14. *Dictyospyris messanensis*, J. Müller.

*Dictyospyris messanensis*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 46, Taf. ii. fig. 8.

*Dictyospyris messanensis*, Haeckel, 1862, Monogr. d. Radiol., p. 291.

Shell nut-shaped, spinulate, with deep sagittal stricture. Pores numerous and small, irregular roundish. No larger annular pores on the sides of the ring. Basal plate with four large, nearly equal, pear-shaped collar pores.

*Dimensions.*—Shell 0·06 long, 0·08 broad.

*Habitat.*—Mediterranean; Messina, surface.

## Subgenus 4. *Dictyospyromma*, Haeckel.

*Definition.*—Basal plate with six or more collar pores.

15. *Dictyospyris hexastoma*, n. sp.

Shell nut-shaped, tuberculate, with deep sagittal stricture. Pores small, irregular, roundish. Three pairs of larger pores on each side of the ring. Basal plate with six large pores; the middle pair (cardinal) twice as large as the anterior (jugular) and the posterior (cervical).

*Dimensions.*—Shell 0·08 long, 0·12 broad.

*Habitat.*—Fossil in Barbados.

16. *Dictyospyris enneastoma*, n. sp.

Shell ellipsoidal, smooth, without external sagittal stricture, but with an internal free sagittal ring. Pores small and numerous, regular, circular. No larger annular pores. Basal plate with nine pores, three larger interradial alternating with three pairs of adradial.

*Dimensions.*—Shell 0·07 long, 0·11 broad.

*Habitat.*—South Pacific, Station 297, depth 1775 fathoms.

17. *Dictyospyris polystoma*, n. sp.

Shell nut-shaped, mammillate, with distinct sagittal stricture. Pores small and numerous, irregular, on each side of the ring three to five times as large as on the lateral sides. Basal plate with twelve large pores (four central and four alternate pairs of peripheral).

*Dimensions.*—Shell 0·1 long, 0·14 broad.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

## Family LIII. THOLOSPYRIDA, n. fam.
## (Pl. 87, figs. 7–10; Pl. 89, figs. 1–4; Pl. 95, figs. 14–16).

*Definition.*—Spyroidea with a galea, but without thorax; the shell being composed of the bilocular cephalis and of an aboral cupola or galea arising from its coryphal face.

The family Tholospyrida differs from the preceding Zygospyrida, its ancestral group, in the development of a galea, *i.e.*, a fenestrated hemispherical or dome-shaped cupola, which covers the upper face of the cephalis like a cap.

Only three species of this family have been hitherto described: *Pylospyris* (or *Spyridobotrys*) *trinacria*, figured in my Monograph (1862), *Pylospyris* (or *Lithopera*) *denticulata*, figured by Ehrenberg (1872), and *Lophospyris* (or *Ceratospyris*) *acuminata*, figured by Hertwig (1879). Fourteen new species have been found in the collection of the Challenger, which we dispose here among five genera. These may be derived from corresponding genera of Zygospyrida by the development of a galea.

The number and disposition of the terminal feet around the basal plate do not vary so much in the Tholospyrida as in the Zygospyrida. We find here only one genus with three feet, *Tholospyris* (corresponding to *Tripospyris*); one genus with two lateral feet, *Lophospyris* (corresponding to *Dipospyris*); and two genera with numerous feet, the horned *Sepalospyris* and the hornless *Tiarospyris* (the former corresponding to *Petalospyris*, the latter to *Gorgospyris*). The fifth genus (*Pylospyris*) has no feet at all, and may be derived from *Circospyris* among the Zygospyrida.

The cephalis exhibits in the Tholospyrida the same typical structure which we have described above of all Spyroidea (compare p. 1017). The cupola or galea, arising from its upper face, seems to be a secondary production, perhaps caused by an apical growth of the central capsule, or in other cases by descending branches of the apical horn, which cover the apical face of the calymma with protecting network.

*Synopsis of the Genera of Tholospyrida.*

| | | | |
|---|---|---|---|
| I. Subfamily Lophospyrida. Two or three basal (cortinar feet). Galea with a horn. | Three basal feet (two paired pectoral and an odd caudal), | 469. | *Tholospyris.* |
| | Two paired basal (pectoral) feet, | 470. | *Lophospyris.* |
| II. Subfamily Tiarospyrida. Numerous basal feet in a corona (six to nine or more). | Galea with a horn, | 471. | *Sepalospyris.* |
| | Galea without a horn, | 472. | *Tiarospyris.* |
| III. Subfamily Pylospyrida. No basal feet. | Galea with a horn, | 473. | *Pylospyris.* |

Genus 469. *Tholospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Tholospyrida with three basal feet and an apical horn.

The genus *Tholospyris* is probably the common ancestral form of the Tholospyrida, and has arisen from *Tripospyris* by development of a galea or cupola; this is composed of the apical horn, the lateral branches of which become connected with lateral spines arising from the coryphal face of the cephalis, and of lattice-work developed between the former and the latter. The three descending feet of the basal face are the typical cortinar feet (one odd caudal and two paired pectoral), the same as in the old ancestral genera *Cortina*, *Plagoniscus*, *Tripospyris*, &c.

Subgenus 1. *Tholospyrium*, Haeckel.

*Definition.*—Basal feet simple, neither forked nor branched.

[1] *Tholospyris*=Basket with a cupola; θόλος, σπυρίς.

1. *Tholospyris tripodiscus*, n. sp. (Pl. 89, fig. 1).

Shell campanulate, smooth, as broad as long, with deep sagittal stricture. Cephalis compressed, with irregular roundish pores; two or three pairs of larger annular pores on each side of the ring. Basal plate with four large pores. Galea with two very large opposite holes (an occipital and a frontal opening). A slender free perpendicular columella connects the uppermost part of the sagittal ring with the strong three-sided pyramidal apical horn. All three feet of equal length, half as long as the ring, three-sided, prismatic, divergent, with three dentated edges.

*Dimensions.*—Shell 0·13 diameter, ring 0·08 long, feet 0·05 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Tholospyris fenestrata*, n. sp. (Pl. 89, fig. 2).

Shell roundish polyhedral, smooth, with slight sagittal stricture. Cephalis nearly cubical, with irregularly roundish pores; two or three pairs of larger pores on each side of the ring. Basal plate with two very large pores. Galea pyramidal, with two large occipital holes. Columella enclosed in the dorsal wall of the galea, prolonged into an oblique pyramidal spine of the same length. Two pectoral feet pyramidal, nearly vertical and as long as the ring, twice as long as the caudal foot.

*Dimensions.*—Shell 0·12 diameter, ring 0·07, pectoral feet 0·05 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Tholospyris galeata*, n. sp.

Shell helmet-shaped, thorny, with deep sagittal stricture. Cephalis campanulate, with subregular circular pores. Basal plate with three large pores. Galea hemispherical, separated from the cephalis by a sharp horizontal stricture; pores smaller. A slender free columella connects the apex of the ring with the strong conical apical horn, which is half as long as the ring. All three feet of equal length, divergent conical, as long as the horn.

*Dimensions.*—Shell 0·14 diameter, ring 0·09 long, feet 0·08 long.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

## Subgenus 2. *Tholospyridium*, Haeckel.

*Definition.*—Basal feet forked or branched.

4. *Tholospyris ramosa*, n. sp. (Pl. 89, fig. 3).

Shell helmet-shaped, smooth, with deep sagittal stricture. Cephalis nearly spherical, with irregularly polygonal pores; four or five pairs of larger annular pores on each side of the strong angular ring. Cupola flat, conical, with two pairs of larger pores. Columella enclosed in its dorsal wall,

bearing an irregularly branched horn. Caudal foot short conical, simple. Two pectoral feet half as long as the shell, angular, subvertical, irregularly branched.

*Dimensions.*—Shell 0·15 diameter, ring 0·1 long, pectoral feet 0·07 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

5. *Tholospyris cupola*, n. sp. (Pl. 89, fig. 4).

Shell pear-shaped or cupola-shaped, smooth, with slight sagittal stricture. Cephalis not distinctly separated from the galea, as the ring in the uppermost part of the shell-wall becomes obliterated. Pores irregularly polygonal, small and numerous. Basal plate with four large pores. Apical horn and the three divergent feet, irregularly branched; feet nearly as long as the shell, about four times as long as the horn.

*Dimensions.*—Shell 0·14 diameter, ring 0·1 long, feet 0·12 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Genus 470. *Lophospyris*,[1] Haeckel, 1881, Prodromus, p. 443 (*sensu emendato*).

*Definition.*—Tholospyrida with two lateral basal feet and an apical horn.

The genus *Lophospyris* differs from the preceding *Tholospyris*, its probable ancestral form, in the absence of the caudal foot, and therefore bears to it the same relation that *Dipospyris* does to *Tripospyris*. The two pectoral feet are alone developed and are placed opposite in the frontal plane. *Lophospyris* may also be derived from *Dipospyris* by the formation of a galea.

1. *Lophospyris dipodiscus*, n. sp. (Pl. 95, fig. 14).

Shell ovate, spinulate, with sharp transverse coronal constriction. Cupola hemispherical, half as large as the nut-shaped cephalis. Pores irregularly roundish, much larger on the sagittal constriction. Apical horn pyramidal, about half as long as the shell. Two lateral feet cylindrical, strongly curved, about as long as the shell, with some irregular branches; together forming a nearly complete circle.

*Dimensions.*—Shell 0·09 long, 0·08 broad; ring 0·04 long, feet 0·08 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Lophospyris acuminata*, Haeckel.

*Ceratospyris acuminata*, R. Hertwig, 1879, Organism. d. Radiol., p. 70, Taf. vii. fig. 2.

Shell campanulate, smooth, without external transverse stricture. Cupola conical, half as long and broad as the nut-shaped cephalis. Pores irregularly roundish, on each side of the sagittal

[1] *Lophospyris* = Basket with a crest; λόφος, σπυρίς.

strictures much larger. Basal plate with four large triangular pores. Apical horn slender, prismatic; its outer free part of the same length as the inner columella, and as the two lateral feet, which are curved, shorter than half the ring.

*Dimensions.*—Shell 0·08 long, 0·09 broad; ring 0·06 long; horn and feet 0·03 long.

*Habitat.*—Mediterranean, Messina (R. Hertwig).

3. *Lophospyris comosa*, n. sp.

Shell ovate, spiny, with deep transverse stricture. Cupola large, campanulate, nearly as long and two-thirds as broad as the nut-shaped cephalis. Pores irregular, roundish, of little different size, Basal plate with numerous (eight to twelve) similar pores. Apical horn large, nearly as long as the shell, surrounded by a bunch of smaller divergent spines. Two lateral feet divergent, larger than the shell, cylindrical; at the distal end irregularly branched, at the base surrounded by some smaller spines.

*Dimensions.*—Shell 0·15 long, 0·11 broad; ring 0·08 long; feet 0·2 long.

*Habitat.*—Western Tropical Pacific, Station 206, depth 2100 fathoms.

## Genus 471. *Sepalospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Tholospyrida with numerous basal feet (eight to twelve or more). Galea with a horn.

The genus *Sepalospyris* has been derived from the similar *Petalospyris* by development of a galea or cupola on the coryphal face of the cephalis, or from *Tholospyris* by multiplication of the basal feet. The latter (in the two observed species from twelve to twenty-five) form a regular corona around the basal plate.

1. *Sepalospyris platyphylla*, n. sp.

Shell ovate, rough, with sharp transverse stricture. Cupola with delicate network, hemispherical, about two-thirds as long and broad as the nut-shaped thorax. Pores of the latter irregular, roundish; two or three pairs of large pores on each side of the sagittal stricture. Apical horn conical, half as long as the shell. Basal coronet with twelve to fifteen broad, lamellar, truncate, vertical feet, somewhat shorter than the cephalis.

*Dimensions.*—Shell 0·12 long, 0·13 broad; ring 0·06 long; horn 0·04; feet 0·05 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Sepalospyris polyphylla*, n. sp.

Shell campanulate, rough, with deep transverse stricture. Cupola hemispherical, about one-third as long and broad as the nut-shaped thorax. Pores irregular, roundish, a little different in

[1] *Sepalospyris* = Basket with leaves; σήπαλον, σπυρίς.

size. Apical horn pyramidal, about as long as the shell. Basal coronet with twenty to twenty-five slender, lamellar, pointed, vertical feet, longer than the shell.

*Dimensions.*—Shell 0·11 long, 0·12 broad; ring 0·07 long; horn 0·1; feet 0·12 to 0·18 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Genus 472. *Tiarospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Tholospyrida with numerous basal feet (eight to twelve or more). Galea without a horn.

The genus *Tiarospyris* has probably been derived from the preceding *Sepalospyris* by reduction and loss of the free apical horn; it therefore bears to it the same relation that the similar *Gorgospyris* does to *Petalospyris*.

### 1. *Tiarospyris pervia*, n. sp. (Pl. 87, fig. 7).

Shell nut-shaped, smooth, with deep sagittal stricture. Cephalis on the lateral sides with numerous small roundish pores, on each side of the ring with a pair of very large holes. Basal plate with two large collar pores. Cupola flat, cap-shaped, with two large parietal pores above the ring. Coronet with eight conical, slightly divergent feet, about one-fourth as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·1 broad; ring 0·06 long; feet 0·02 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 2. *Tiarospyris galea*, n. sp.

Shell helmet-shaped, with deep sagittal stricture. Cephalis with irregular, polygonal pores; on each side of the ring two pairs of larger annular pores. Basal plate with four large pores. Cupola high, conical, nearly as long as the cephalis, separated from it by a distinct coronal stricture. Basal coronet with twelve to sixteen slender curved divergent feet, nearly as long as the shell.

*Dimensions.*—Shell 0·16 long, 0·12 broad; ring 0·1 long; feet 0·15 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### 3. *Tiarospyris mitra*, n. sp. (Pl. 87, figs. 9, 10).

Shell subspherical, smooth. Cephalis on the lateral sides with small roundish, double-contoured pores, on each side of the ring with three to five pairs of larger pores, each of which is closed by a thin fenestrated lamella (different on the frontal face, fig. 9, and the dorsal face, fig. 10). Cupola flat, cap-shaped, separated by a distinct coronal stricture, with smaller pores. Basal coronet with ten to twelve short conical convergent feet.

*Dimensions.*—Shell 0·11 long, 0·12 broad; ring 0·04 long; feet 0·02 long.

*Habitat.*—West Tropical Pacific, Station 225, depth 4475 fathoms.

[1] *Tiarospyris*=Basket with a cap; τιάρα, σπυρίς.

4. *Tiarospyris amphora*, n. sp. (Pl. 87, fig. 8).

Shell amphora-shaped, in the upper half smooth, in the lower spiny, without external sagittal stricture. Cephalis subspherical, with a small number of irregular, large, roundish pores, which are closed by a thin fenestrated lamella. Cupola flat, cap-shaped, with numerous small pores. Base covered with numerous conical divergent feet of different sizes, the largest one-third as long as the shell. Internal sagittal ring ovate, nearly free.

*Dimensions.*—Shell 0·14 long, 0·13 broad; ring 0·1 long; feet 0·04 long.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

## Genus 473. *Pylospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Tholospyrida without basal feet, with an apical horn.

The genus *Pylospyris* was first known from a Mediterranean species, called by me, in 1862, *Spyridobotrys trinacria*. As this name was given erroneously, on the supposition of a near relation to the Botryodea (=Polycyrtida), I changed it afterwards to *Pylospyris*. This genus differs from the other Tholospyrida in the total absence of basal feet, and may therefore be derived either from them by reduction of the feet, or from *Dictyospyris* by formation of a galea.

1. *Pylospyris denticulata*, Haeckel.

*Lithopera denticulata*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. xii. II. fig. 7.

*Lithobotrys denticulata*, Ehrenberg, 1844, Monatsber. d. Akad. Berlin, p. 203.

Shell spinulate, with slight coronal and deep sagittal constriction, with irregular, roundish pores of variable size. Galea hemispherical, about half as long and broad as the nut-shaped cephalis. No symmetrically disposed larger pores.

*Dimensions.*—Galea 0·04 long, 0·06 broad; cephalis 0·08 long, 0·1 broad.

*Habitat.*—Antarctic Ocean, Ehrenberg. (Included in the ice.)

2. *Pylospyris trinacria*, Haeckel.

*Spyridobotrys trinacria*, Haeckel, 1862, Monogr. d. Radiol., p. 341, Taf. xii. figs. 8, 9.

Shell tuberculate, with sharp coronal and sagittal stricture. Galea campanulate, with very small circular pores, and a short conical apical horn of the same length. Cephalis nut-shaped, with large, irregular, roundish pores; two pairs of larger annular pores on each side of the sagittal ring, also four larger pores in the basal plate.

*Dimensions.*—Galea 0·03 long, 0·04 broad; cephalis 0·04 long, 0·07 broad.

*Habitat.*—Mediterranean, Messina, surface.

[1] *Pylospyris*=Basket with gates; πύλη, σπυρίς.

3. *Pylospyris canariensis*, n. sp. (Pl. 95, fig. 16).

Shell rough, with deep coronal and slight sagittal constriction. Galea hemispherical, with numerous small irregular, roundish. pores, about half as long as the cephalis, with a slender conical horn of twice the length. Cephalis nut-shaped, with larger roundish pores of very unequal size, three pairs of larger pores on each side of the ring. Basal plate with two larger pores.

*Dimensions.*—Galea 0·03 long, 0·08 broad; cephalis 0·06 long, 0·11 broad.

*Habitat.*—North Atlantic, Canary Islands, surface.

## Family LIV. PHORMOSPYRIDA, Haeckel (*sensu emendato*) (Pl. 83, figs. 13–15; Pl. 95, figs. 17–19).

*Phormospyrida*, Haeckel, 1881, Prodromus, p. 442.

*Definition.*—Spyroidea with a thorax, without galea; the shell composed of the bilocular cephalis and of a simple thorax arising from its basal face.

The family Phormospyrida differs from the Zygospyrida, their ancestral group, in the development of a thorax, or a second fenestrated shell-joint, which arises from the lower face of the cephalis. It corresponds, therefore, to the Dicyrtida among the Cyrtoidea, and may perhaps be, wholly or partially, the ancestral group of the latter. When the sagittal ring and the longitudinal constriction of the cephalis disappear, the Phormospyrida pass over into the Dicyrtida.

Only three species of this family have been hitherto known, which were found fossil in Barbados, and described by Ehrenberg (1875) as *Lithobotrys stiligera* and *Petalospyris confluens*, and by Bütschli (1882) as *Petalospyris anthocyrtoides*. Fifteen other species are found in the Challenger collection, which we dispose here among five genera.

Two of these five genera (the horned *Acrospyris* and the hornless *Phormospyris*) possess the three typical basal feet of *Cortina* and *Tripospyris*, and may be derived from these genera by the development of network between the bases of the feet. The three other genera possess numerous feet, and may be derived in the same way from the Polyspyrida; the apical face differs in the three genera, in *Desmospyris* it is hornless, in *Patagospyris* it bears an apical horn, and in Rhodospyris three horns (an apical and two lateral or frontal).

The cephalis in the Phormospyrida exhibits the same typical structure, which we have described above, of all Spyroidea (compare, p. 1017). The thorax or the second joint of the shell arises by reticular connection of the bases of the basal feet, and represents a cylindrical or truncate-conical joint in the polypodal forms, or a three-sided joint in the tripodal forms. The terminal aperture or the mouth of the thorax is constantly open, and surrounded by the free ends of the feet.

*Synopsis of the Genera of Phormospyrida.*

| | | |
|---|---|---|
| I. Subfamily Acrospyrida. Three basal cortinar feet (one odd caudal and two paired pectoral). | One apical horn, . . . . | 474. *Acrospyris.* |
| | No apical horn, . . . . | 475. *Phormospyris.* |
| II. Subfamily Rhodospyrida. Numerous basal feet in a corona (nine to twelve or more). | One apical horn, . . . . | 476. *Patagospyris.* |
| | Three apical horns, . . . | 477. *Rhodospyris.* |
| | No apical horn, . . . . | 478. *Desmospyris.* |

Subfamily 1. ACROSPYRIDA, Haeckel, 1881, Prodromus, p. 441 (*sensu emendato*).

*Definition.*—Phormospyrida with three basal feet (an odd caudal and two paired pectoral).

Genus 474. *Acrospyris*,[1] Haeckel, 1881, Prodromus, p. 441.

*Definition.*—Phormospyrida with three basal feet and one apical horn.

The genus *Acrospyris* is probably the oldest and most primitive among the Phormospyrida, perhaps the original ancestral form of this family. It has been derived from *Tripospyris* by the development of lattice-work between the three basal feet, forming a second joint or thorax. It has also therefore a close relation to the simplest forms of the triradiate Dicyrtida: *Dictyophimus*, *Clathrocanium*, &c. It differs from these in the distinct sagittal constriction of the cephalis, which divides it into two lateral loculi.

1. *Acrospyris clathrocanium*, n. sp. (Pl. 95, fig. 17).

Shell tuberculate, with distinct collar and deep sagittal stricture. Cephalis nut-shaped, with numerous irregular, roundish pores; three pairs of larger annular pores on each side of the ring. Basal plate with four larger pores (two major cardinal and two minor jugular pores). Apical horn slender, pyramidal, curved, about as long as the shell, with three recurved short spines. Thorax three-sided, about twice as large as the cephalis, with three large basal holes and a broad riband with numerous smaller holes; three ribs between them stout, pyramidal, strongly curved, prolonged into three convergent crescentic feet.

*Dimensions.*—Cephalis 0·08 long, 0·11 broad; thorax 0·14 long, 0·16 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Acrospyris dictyophimus*, n. sp.

Shell smooth. Cephalis and thorax of nearly the same structure and form as in the preceding species; it differs from the latter in the shape of the three stout basal feet, which are

[1] *Acrospyris* = Basket with an apical spine; ἄκρα, σπυρίς.

straight, much longer than the thorax, divergent, and at the broader base irregularly fenestrated, without three larger holes.

*Dimensions.*—Cephalis 0·05 long, 0·08 broad; thorax 0·07 long, 0·12 broad.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

3. *Acrospyris pyramidalis*, n. sp.

Shell three-sided pyramidal, with slight collar stricture. Cephalis campanulate, with deep sagittal stricture and stout ring, armed with a strong pyramidal horn of the same length. Thorax shorter and broader, truncate. Pores irregular, roundish, scarce. Three feet divergent, three-sided pyramidal, as long as the cephalis.

*Dimensions.*—Cephalis 0·05 long, 0·06 broad; thorax 0·02 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

4. *Acrospyris macrocephala*, n. sp.

Shell spinulate, with deep sagittal and very deep collar stricture. Cephalis very large, nut-shaped, twice as long and broad as the small, truncate, pyramidal thorax. Pores irregular, roundish. Horn spindle-shaped, nearly as long as the cephalis; the three divergent feet are of the same form and size as the horn, and arise as three ribs from the deep collar stricture.

*Dimensions.*—Cephalis 0·1 long, 0·15 broad; thorax 0·05 long, 0·09 broad.

*Habitat.*—Fossil in Barbados.

5. *Acrospyris fragilis*, n. sp.

Shell very thin-walled and fragile, with deep sagittal and collar strictures. Pores very small and numerous, circular. Cephalis nut-shaped, nearly spherical, with a slender bristle-shaped horn of the same length. Basal stricture with two large collar pores only (luminella). Thorax nearly three-sided prismatic, longer than the cephalis, with three parallel ribs, prolonged into three slender, long, bristle-shaped feet.

*Dimensions.*—Cephalis 0·05 long, 0·06 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—North Pacific, Station 244, surface.

Genus 475. *Phormospyris*,[1] Haeckel, 1881, Prodromus, p. 442 (*sensu emendata*).

*Definition.*—Phormospyrida with three basal feet, without apical horn.

The genus *Phormospyris* has been derived from *Acrospyris*, its ancestral form, by reduction and loss of the apical horn; it therefore bears to the latter the same relation that *Tristylospyris* has to the ancestral *Tripospyris*.

[1] *Phormospyris* = Wicker-basket; φορμός, σπυρίς.

1. *Phormospyris tricostata*, n. sp. (Pl. 83, fig. 15).

Cephalis nut-shaped, thorny, with deep sagittal and collar strictures, half as large as the pyramidal thorax. Mouth of the latter dilated and ciliated, twice as broad as the cephalis. Pores irregular, polygonal, with thin bars. Three cylindrical, straight, divergent ribs descend in the wall of the thorax, and are prolonged over the mouth into three short conical teeth.

*Dimensions.*—Cephalis 0·06 long, 0·09 broad; thorax 0·08 long, 0·16 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Phormospyris tridentata*, n. sp. (Pl. 95, fig. 18).

Cephalis nut-shaped, with deep sagittal and collar strictures, about twice as large as the thorax. Mouth of the latter half as broad as the cephalis. Pores very small and numerous, subregular, circular. Collar plate with four large triangular pores. In the wall of the thorax three vertical prismatic ribs descend, which are prolonged over the mouth into three parallel feet of the same length.

*Dimensions.*—Cephalis 0·06 long, 0·08 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

3. *Phormospyris trifoliata*, n. sp.

Cephalis nut-shaped, with deep sagittal and collar strictures, smaller than the thorax. Mouth of the latter nearly as broad as the cephalis. Pores circular, double-contoured, larger in the thorax than in the cephalis. The thorax has no lateral ribs, but bears around the mouth three large triangular lamellar terminal feet.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·06 long, 0·05 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Subfamily 2. RHODOSPYRIDA, Haeckel.

*Definition.*—Phormospyrida with a corona of numerous (nine to twelve or more) basal feet.

### Genus 476. *Patagospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Phormospyrida with numerous basal feet (nine to twelve or more) and an apical horn.

The genus *Patagospyris* and the two following closely allied genera differ from the two preceding tripodal genera in the multiplication of the basal feet, and therefore have to the latter the same relation that the Polyspyrida (*Petalospyris*) bear to the Tripospyrida (*Tripospyris*). When the numerous basal feet of *Petalospyris* become connected by lattice-work, *Patagospyris* arises.

[1] *Patagospyris* = Basket with a patagium; πάταγεῖον, σπυρίς.

1. *Patagospyris confluens*, Haeckel.

*Petalospyris confluens*, Ehrenberg, 1885, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xxii. fig. 5.

Shell tuberculate, with distinct sagittal and collar strictures. Pores irregular, roundish. Cephalis nut-shaped, larger than the short truncate thorax. Horn conical, shorter than the cephalis. Peristome with a coronet of twelve to fifteen short triangular feet, which are parallel and vertical, slightly curved and shorter than the thorax.

*Dimensions.*—Cephalis 0·05 long, 0·07 broad; thorax 0·03 long, 0·07 broad.

*Habitat.*—Fossil in Barbadoes.

2. *Patagospyris lanceolata*, n. sp.

Shell tuberculate, with slight sagittal and sharp collar strictures. Pores subregular, circular. Cephalis subspherical, about as large as the truncate subcylindrical thorax. Horn spindle-shaped, about as long as the cephalis. Peristome with a coronet of fifteen to twenty divergent lanceolate lamellar feet, longer than the thorax.

*Dimensions.*—Cephalis 0·08 long, 0·09 broad; thorax 0·07 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

3. *Patagospyris stiligera*, Haeckel.

*Lithobotrys stiligera*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iii. fig. 17.

Shell smooth, hyaline, with deep sagittal and collar strictures. Pores very small and few. Cephalis nut-shaped, bilobed, of the same breadth as the cylindrical thorax. Horn conical, about as long as the cephalis. Peristome with a coronet of six to nine broad lamellar feet (in Ehrenberg's figure broken off).

*Dimensions.*—Cephalis 0·04 to 0·05 diameter; thorax 0·06 long, 0·05 broad.

*Habitat.*—Fossil in Barbados.

4. *Patagospyris anthocyrtis*, n. sp. (Pl. 95, fig. 19).

Shell smooth, with deep sagittal and deep collar strictures. Pores irregular, roundish, of various sizes, numerous. Cephalis nut-shaped, with two inflated bosoms, about twice as broad as the short cylindrical thorax. Horn stout, pyramidal, about as long as the cephalis. Peristome with a coronet of fifteen to twenty parallel and vertical triangular lamellar feet, nearly as long as the thorax.

*Dimensions.*—Cephalis 0·05 long, 0·1 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Genus 477. *Rhodospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Phormospyrida with numerous basal feet (nine to twelve or more), and with three coryphal horns.

[1] *Rhodospyris* = Rose-basket; ῥόδον σπυρίς.

The genus *Rhodospyris* differs from the preceding *Patagospyris* in the development of three coryphal horns (one odd middle apical horn, and two paired frontal horns on each of its sides), and therefore bears the same relation to the latter that the similar *Anthospyris* does to *Petalospyris*. When the numerous basal feet of *Anthospyris* become connected by lattice-work, *Rhodospyris* arises.

1. *Rhodospyris tricornis*, n. sp. (Pl. 83, fig. 13).

Cephalis nut-shaped, with deep sagittal stricture, and three short apical horns of half its length; the middle odd horn is straight, the two paired lateral horns are curved outwards. Thorax somewhat larger than the cephalis, dilated around the wide open mouth, with a coronet of twenty-five to thirty slender basal feet, which are slightly curved and convergent, about as long as the thorax. Pores small, numerous and circular.

*Dimensions.*—Cephalis 0·05 long, 0·07 broad; thorax 0·06 long, 0·08 broad; horns 0·02 long, feet 0·06 long.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

2. *Rhodospyris triceros*, n. sp.

Cephalis nut-shaped, with deep sagittal and deep collar stricture, and with three stout divergent horns of nearly equal length. Thorax cylindrical, twice as long as the cephalis, and of the same breadth, with a coronet of twelve to sixteen broad, lamellar, rectangular, perpendicular feet around the mouth, about as long as the cephalis. Pores rather large, subregular, circular.

*Dimensions.*—Cephalis 0·06 long, 0·08 broad; thorax 0·12 long, 0·09 broad.

*Habitat.*—Indian Ocean, Singapore (Trebing), surface.

Genus 478. *Desmospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Phormospyrida with numerous basal feet (nine to twelve or more), without a coryphal horn.

The genus *Desmospyris* differs from the two preceding polypodal genera in the complete absence of horns on the coryphal face of the cephalis. It therefore corresponds to *Gorgospyris* among the Zygocyrtida, and arises when the numerous basal feet of the latter become connected by lattice-work.

1. *Desmospyris mammillata*, n. sp. (Pl. 83, fig. 14).

Shell mammillate, with deep sagittal and slight collar constriction. Pores irregular, roundish. Cephalis nut-shaped, larger than the inversely conical thorax, and twice as broad as the constricted

[1] *Desmospyris* = Basket with a band or string; δεσμός, σπυρίς.

mouth. Coronet of the peristome with twelve to fifteen short conical convergent feet, shorter than half the thorax.

*Dimensions.*—Cephalis 0·06 long, 0·09 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 2. *Desmospyris cyrtocolpos*, n. sp.

Shell smooth, with deep sagittal and collar strictures. Pores subregular, circular, double-contoured, very small and numerous. Cephalis nut-shaped, larger than the short truncate thorax. Coronet with eighteen to twenty-four slender, irregular, pointed, convergent feet, about twice as long as the thorax.

*Dimensions.*—Cephalis 0·08 long, 0·12 broad; thorax 0·04 long, 0·1 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 3. *Desmospyris anthocyrtoides*, Haeckel.

*Petalospyris anthocyrtoides*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 533, 539, Taf. xxxii. fig. 19, *a–c*.

Shell tuberculate, with slight sagittal and sharp collar strictures. Pores subregular, circular. Cephalis nut-shaped, larger than the short truncate thorax. Coronet with fifteen to twenty short conical, parallel and vertical feet, about as long as the thorax.

*Dimensions.*—Cephalis 0·06 long, 0·09 broad; thorax 0·02 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

### 4. *Desmospyris carpocanium*, n. sp.

Shell smooth, with slight sagittal and slight collar strictures. Pores subregular, circular, small and numerous. Cephalis campanulate, smaller than the ovate thorax. Coronet with fifteen to twenty irregular lamellar feet, which are longer than the thorax, pointed, nearly vertical and parallel.

*Dimensions*—Cephalis 0·05 long, 0·08 broad; thorax 0·07 long, 0·1 broad.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

## Family LV. ANDROSPYRIDA, n. fam. (Pl. 88–90).

*Definition.*—Spyroidea with galea and thorax; the shell composed of a bilocular cephalis and of two secondary joints, a galea arising from its upper face, and a thorax arising from its lower face.

The family Androspyrida differs from the three preceding families of Spyroidea in the three-jointed shell, in which the galea of the Tholospyrida and the thorax of the Phormospyrida are combined; it may therefore be derived from the latter by development of a galea, or from the former by formation of a thorax. The common ancestral group of these three families is probably the Zygospyrida. But it may be that a part of the Androspyrida has originated directly from the Stephoidea.

Two species only of this family were hitherto known, *Amphispyris reticulata* (figured, in 1872, by Ehrenberg, as *Dictyospyris*) and *Sphærospyris sphæra* (described, in 1882, by Bütschli, as *Dictyospyris*). Thirty new species were found in the collection of the Challenger, and are here disposed in seven genera. But perhaps these may represent three different families, which we here enumerate as subfamilies; the Lamprospyrida, Perispyrida, and Nephrospyrida.

The Lamprospyrida, the first subfamily, are tripodal Spyroidea with galea and thorax; they may therefore be regarded as a combination of *Tholospyris* and *Acrospyris*. In the simpler form, *Androspyris* (Pl. 83, fig. 8), the network of the shell is simple, and allows a very clear recognition of the internal structure. In the splendid *Lamprospyris*, derived from it (Pl. 89, figs. 13, 14) the delicate network is more or less spongy. The large apical horn is branched and fenestrated in the latter and simple in the former.

The Perispyrida, the second subfamily, possess no free apophyses, but a three-jointed shell with two distinct transverse strictures, an upper mitral and a lower collar stricture. The network of this shell is incomplete in *Amphispyris* (Pl. 88, figs. 2–7), being developed only in the frontal or lateral perimeter, thus making it probable that this subfamily may have arisen directly from the Tympanida (*Toxarium*, Pl. 88, fig. 1; Pl. 93, figs. 18–20). The network of *Tricolospyris* (Pl. 88, figs. 8–11) is complete, of another shape in the cephalis than in the galea and thorax; it is doubled or spongy in *Perispyris* (Pl. 88, figs. 12, 13).

The Nephrospyrida, the third subfamily, contains two very different genera only, each of which may represent a separate family. *Sphærospyris* (Pl. 83, fig. 4) possesses a spherical or subspherical lattice-shell, the central part of which includes a sagittal ring, connected with the inner face of the sphere by a number of paired apophyses, corresponding to those of *Lithocircus;* it may be easily confounded with some Sphæroidea (*Carposphæra*), but the enclosed ring leaves no doubt as to its true origin. *Nephrospyris* (Pl. 90) has a flat discoidal shell of considerable size, usually kidney-shaped or cordate, with a deep sagittal incision at the base, indicating the region where the pseudopodia are protruded from the porochora. The violin-shaped central capsule has two large lateral lobes on each side of the including sagittal ring, and the transverse nucleus is perpendicular to its sagittal plane (Pl. 90, figs. 7, 10). *Sphærocircus* as well as *Nephrospyris* have probably arisen independently from the Stephanida.

*Synopsis of the Genera of Androspyrida.*

| | | | |
|---|---|---|---|
| I. Subfamily Lamprospyrida. Three free basal feet. | Lattice-work simple, not spongy. | Apical horn usually simple, not fenestrated, . . | 479. *Androspyris.* |
| | Lattice-work wholly or partly spongy. | Apical horn usually branched and fenestrated, . . | 480. *Lamprospyris.* |
| II. Subfamily Perispyrida. *No free basal feet. Shell three-jointed.* | Shell with two transverse coronal strictures (one *superior mitral* and one inferior collar stricture). | Lattice-work only complete in the frontal ring, . . | 481. *Amphispyris.* |
| | | Lattice-work complete on all sides, . . . | 482. *Tricolospyris.* |
| | | Lattice-work double or spongy, | 483. *Perispyris.* |
| III. Subfamily Nephrospyrida. No free basal feet. Shell spherical or discoidal. | Shell without external transverse stricture. | Shell spherical or subspherical, | 484. *Sphærospyris.* |
| | | Shell discoidal, kidney-shaped or subcircular, . . | 485. *Nephrospyris.* |

## Subfamily 1. LAMPROSPYRIDA, Haeckel.

*Definition.*—Androspyrida with three free basal feet (an odd posterior caudal foot and two paired anterior pectoral feet).

### Genus 479. *Androspyris*,[1] n. gen.

*Definition.*—Androspyrida with three free basal feet and a simple apical horn; lattice-work of the three-jointed shell simple, not spongy.

The genus *Androspyris* is probably the most original form of the Androspyrida, and represents, together with the following *Lamprospyris*, the subfamily of Lamprospyrida, which always possess three free basal feet, an odd posterior or caudal foot, and two paired anterior or pectoral feet. It may be derived either from *Acrospyris* by development of a cupola, or from *Tholospyris* by development of a thorax; the common ancestral form of these three typical genera is, no doubt, *Tripospyris*. Some species of *Androspyris* reach a considerable size and are distinguished by a peculiar external form resembling somewhat a human figure.

1. *Androspyris homunculus*, n. sp.

Shell thorny, with two deep transverse constrictions and irregular polygonal pores. Galea subspherical, with a strong pyramidal oblique horn, about two-thirds as large as the cephalis, which has the form of a human thorax, includes a strong ovate sagittal ring, and bears on each side a stronger lateral spine. Thorax short and broad, prolonged into three latticed divergent feet; the

[1] *Androspyris*=Man-like wicker basket; *ἀνήρ*, *σπυρίς*.

two lateral (pectoral) feet are like the legs of a human body, and are twice as long as the cephalis and as the tail-like caudal feet. (The whole shell exhibits a curious similarity to a human figure, more than in the following nearly allied species.)

*Dimensions.*—Length of the shell (including horn and feet) 0·4, breadth 0·1 to 0·15.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

2. *Androspyris anthropiscus*, n. sp. (Pl. 83, fig. 8).

Shell rough, with two distinct transverse constrictions and irregular polygonal pores. Galea ovate, with a slender conical oblique horn, about as large as the cephalis, which exhibits a deep longitudinal furrow in the sagittal dorsal line. Thorax half as long, prolonged into three short latticed feet; the terminal spines of the two lateral feet are vertical and parallel, that of the caudal foot larger, directed obliquely backwards.

*Dimensions.*—Length of the shell (including horn and feet) 0·35, breadth 0·1 to 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Androspyris pithecus*, n. sp. (Pl. 95, fig. 20).

Shell smooth, with two slight transverse constrictions. Galea conical, with a short conical horn, longer than the nut-shaped cephalis. Thorax with three nearly vertical and parallel feet of equal length. Pores in the galea and thorax very small and numerous, circular, in the cephalis much larger, irregular, roundish.

*Dimensions.*—Length of the shell (including horns and feet) 0·25, breadth 0·06 to 0·08.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

4. *Androspyris aptenodytes*, n. sp.

Shell smooth, with two slight transverse constrictions and irregular, roundish pores. Galea hemispherical, with a short conical horn, about as large as the roundish cephalis and half as large as the ovate thorax. The three feet arise immediately beyond the collar stricture, are equal, divergent, curved, about as long as the cephalis, and are not terminal (as in the three preceding species), but lateral appendages of the thorax.

*Dimensions.*—Length of the shell 0·2, breadth 0·05 to 0·07.

*Habitat.*—Antarctic Ocean, Station 157, depth 1950 fathoms.

Genus 480. *Lamprospyris*,[1] Haeckel, 1881, Prodromus, p. 447.

*Definition.*—Androspyrida with three free basal feet and a fenestrated apical horn; lattice-work of the three-jointed shell wholly or partly spongy.

The genus *Lamprospyris* differs from the preceding *Androspyris*, its ancestral form, mainly in the higher development of the lattice-work of the large shell. Whilst this in

[1] *Lamprospyris* = Splendid wicker-basket; λαμπρός, σπυρίς.

the latter genus is a simple lattice-plate, it here becomes more or less spongy, and sometimes forms a very dense and delicate wickerwork. The apical horn and the three basal feet are commonly also fenestrated. The two annular strictures, which separate the cephalis from the conical cupola and the inflated thorax, are commonly not so distinct as in the preceding genus. Some species belong to the largest Spyroidea and reach more than half a millimetre in length.

1. *Lamprospyris darwinii*, n. sp. (Pl. 89, fig. 13).

Shell nearly pear-shaped, with two distinct annular strictures, and uneven papillate surface. The total length is equal to twice the greatest breadth, and to seven times the length of the ring. Apical horn free, irregularly branched and fenestrated, as long as the included columella beyond it. The three diverging feet are strongly curved, S-shaped, and completely included by loose lattice-work. In the middle of their length they give off a simple strong lateral branch. The loose arachnoidal lattice-work is rather equally developed.

*Dimensions.*—Length of the entire shell (including the apophyses) 0·5, greatest breadth 0·25, ring 0·07 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Lamprospyris lyellii*, n. sp.

Shell slender, pear-shaped, very similar to the preceding species, but differing in the following characters—the branched horn is much larger and twice as long as the columella; the two annular transverse strictures (separating the three joints) are deeper. The free lateral branches of the three included feet are forked. Lattice-work looser than in the preceding species.

*Dimensions.*—Length of the entire shell 0·6, breadth 0·2, ring 0·09 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Lamprospyris huxleyi*, n. sp. (Pl. 89, fig. 14).

Shell ovate, spiny, with two slight annular transverse strictures; their length equal to one and a half times the breadth, and up to seven times the length of the ring. Apical horn quite included by the loose lattice-work of the large conical cupola, which is as long as the cephalis and thorax together. The three slender feet are also included in the lattice-work and only one-third as long as the shell, nearly vertical. Lattice-work much denser than in the two preceding species.

*Dimensions.*—Length of the shell 0·4, breadth 0·26, ring 0·06 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

4. *Lamprospyris hookeri*, n. sp.

Shell ovato-conical, very similar to the preceding species, but smooth, not spiny. The apical horn and the three feet are much longer, not included in the network, but freely prominent, half

as long as the shell and nearly vertical, parallel. The arachnoidal lattice-work is much denser in the middle third (cephalis) than in the upper third (cupola) or the lower third (thorax).

*Dimensions.*—Length of the shell (without appendages) 0·45, breadth 0·3, ring 0·08 long.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

5. *Lamprospyris spenceri*, n. sp.

Shell slender, ovate, very similar to the preceding species; differing from it in the larger cupola, which is as long as the cephalis and thorax together. The three feet are much shorter and weaker, more divergent. This differs from all four preceding species in the possession of a large double apical horn; the two horns are strong, pyramidal, straight, strongly divergent, and as long as the cupola.

*Dimensions.*—Length of the shell (without the appendages) 0·3, breadth 0·2, ring 0·05 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Subfamily 2. PERISPYRIDA, Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Androspyrida without free basal feet, with three distinct joints separated by two parallel transverse strictures.

## Genus 481. *Amphispyris*,[1] Haeckel, 1881, Prodromus, p. 444.

*Definition.*—Androspyrida without free basal feet, with three distinct joints, separated by two transverse strictures; lattice-work of the shell only complete in the frontal ring, with large open holes on the ventral and dorsal face.

The genus *Amphispyris* and the two following genera arising from it, represent together the peculiar small subfamily of Perispyrida. This may have originated directly from *Toxarium* (family Tympanida, Pl. 88, fig. 1; Pl. 93, figs. 18–20), the large holes between its arches and rings becoming filled up by lattice-work; in *Amphispyris* this intercalated network remains incomplete on the ventral and dorsal faces, whilst in *Tricolospyris* it becomes complete, and in *Perispyris* spongy.

### Subgenus 1. *Amphispyrium*, Haeckel.

*Definition.*—On each side of the ring-plane three pairs of large annular meshes; no middle zygomatic ring is developed between the two tympanic transverse rings (superior orbital and inferior maxillary ring).

[1] *Amphispyris* = Basket with a cap on both sides; ἀμφί, σπυρίς.

1. *Amphispyris thorax*, n. sp. (Pl. 88, fig. 4).

Shell thorax-shaped, as long as broad, with a deep sternal incision and two slight transverse strictures. On each side of the ring-plane three pairs of large, irregular, annular holes of nearly equal size, the middle holes nearly half as broad as the shell. No zygomatic bars between the orbital and maxillary bars. Lateral lattice-girdle narrow, with few small roundish meshes.

*Dimensions.*—Shell 0·17 long, 0·17 broad, ring 0·06 long.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

2. *Amphispyris quadrigemina*, n. sp. (Pl. 88, fig. 6).

Shell shaped like the "corpora quadrigemina cerebralia," with two deep crossed strictures, a coronal transverse stricture and a sagittal sternal stricture. On each side of the ring plane three pairs of large, irregular, annular, double holes, the middle holes larger than the upper and lower holes, and about one-fourth as long as the shell. No zygomatic bars between the orbital and maxillary bars. Lateral lattice-girdle broad, with numerous small meshes.

*Dimensions.*—Shell 0·13 long, 0·16 broad, ring 0·07 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Amphispyris reticulata*, Haeckel.

*Dictyospyris reticulata*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 289, Taf. x. fig. 19.

Shell thorax-shaped, one and one-fifth times as long as broad, with a deep sternal incision and two distinct transverse strictures. On each side of the ring-plane three pairs of large annular holes of nearly equal size, about one-third as long as the shell. No zygomatic bars between the orbital and maxillary bars. Lateral girdle narrow, with few large polygonal meshes.

*Dimensions.*—Shell 0·18 long, 0·15 broad.

*Habitat.*—Indian Ocean, Zanzibar, depth 2200 fathoms (Pullen).

## Subgenus 2. *Amphispyridium*, Haeckel.

*Definition.*—On each side of the ring-plane four pairs of larger annular meshes; a middle horizontal zygomatic ring is developed between the two tympanic transverse rings (superior orbital and inferior maxillary ring).

4. *Amphispyris sternalis*, n. sp. (Pl. 88, fig. 2).

Shell thorax-shaped, one and one-fifth times as long as broad, with deep sternal incision and two distinct transverse (tympanic) strictures. On each side of the ring-plane four pairs of large irregular, annular holes; the fourth (inferior or buccal) pair is the longest. The middle of the sagittal ring

is crossed by horizontal zygomatic bars (between the ascending orbital and the descending maxillary bars). Lateral lattice-girdle narrow, with few large meshes.

*Dimensions.*—Shell 0·24 long, 0·2 broad; ring 0·09 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

5. *Amphispyris subquadrata*, n. sp. (Pl. 88, fig. 5).

Shell compressed, nearly square, spiny, with slight sternal incision and two distinct transverse strictures. Similar to the preceding species; four pairs of irregular annular pores of nearly equal size. Zygomatic ring complete. Lateral lattice-girdle narrow, with few large meshes.

*Dimensions.*—Shell 0·14 long, 0·12 broad; ring 0·06 long.

*Habitat.*—Central Pacific, Station 285, depth 2275 fathoms.

6. *Amphispyris costata*, n. sp. (Pl. 88, fig. 3).

Shell compressed, nearly square, with slight sternal incision and two obliterated transverse strictures. Similar to the two preceding species; with four pairs of large annular pores, the two middle of which (the orbital and nasal holes) are much larger than the superior (frontal) and inferior (oral) holes. Zygomatic ring incomplete. Lateral lattice-girdle broad, with very numerous, small, irregular, polygonal pores.

*Dimensions.*—Shell 0·2 long, 0·16 broad; ring 0·07 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

7. *Amphispyris toxarium*, n. sp. (Pl. 88, fig. 7).

Shell inflated, with deep sternal incision and two distinct transverse strictures. Similar to the preceding species, but with deeper constriction and looser lattice-work. Four pairs of large, irregular, annular pores, the central two of which are much larger. Zygomatic ring complete. Lateral girdle broad, with irregular pores of very different size.

*Dimensions.*—Shell 0·2 long, 0·14 broad; ring 0·09 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Genus 482. *Tricolospyris*,[1] Haeckel, 1881, Prodromus, p. 443.

*Definition.*—Androspyrida without free basal feet, with three distinct joints, separated by two transverse strictures; lattice-work of the shell complete, simple.

The genus *Tricolospyris* has arisen from the preceding *Amphispyris*, its ancestral form, by development of lattice-work which completely closes the large open holes remaining on the ventral and dorsal faces of the latter.

[1] *Tricolospyris*=Wicker-basket with three joints; τρικώλος, σπυρίς.

1. *Tricolospyris kantiana*, n. sp. (Pl. 88, fig. 10).

Shell smooth, one and a half times as long as broad, with two deep transverse strictures. Pores of the cephalis large, roundish, of nearly equal size. Cupola and thorax hemispherical, of about the same size and form, with numerous and small, double-contoured, roundish pores.

*Dimensions.*—Shell 0·12 long, 0·08 broad; ring 0·04 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Tricolospyris leibnitziana*, n. sp. (Pl. 88, fig. 9).

Shell spiny, twice as long as broad, with two deep transverse strictures. Pores of the cephalis large, roundish, polygonally framed, of very different size; two middle transverse rows of smaller pores enclosed between a superior and an inferior row of very large pores. Cupola and thorax hemispherical, about equal, with much smaller and very numerous roundish pores.

*Dimensions.*—Shell 0·15 long, 0·07 broad; ring 0·06 long.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

3. *Tricolospyris baconiana*, n. sp. (Pl. 88, fig. 8).

Shell rough, twice as long as broad, with two sharp strictures. Pores of the cephalis large, very irregular, partly lobated. Cupola hemispherical, smaller than the campanulate thorax, both with smaller irregular pores.

*Dimensions.*—Shell 0·15 long, 0·08 broad; ring 0·06 long.

*Habitat.*—Western Tropical Pacific, Station 215, depth 2500 fathoms.

4. *Tricolospyris newtoniana*, n. sp. (Pl. 88, fig. 11).

Shell spiny, slender, three times as long as broad, with two distinct strictures. Pores of the cephalis very large, irregular. Cupola hemispherical, only one-third as long as the slender inversely conical abdomen, both with irregular, much smaller pores.

*Dimensions.*—Shell 0·22 long, 0·08 broad; ring 0·05 long.

*Habitat.*—Western Tropical Pacific, Station 206, depth 2100 fathoms.

Genus 483. *Perispyris*,[1] Haeckel, 1881, Prodromus, p. 444.

*Definition.*—Androspyrida without free basal feet, with three distinct joints, separated by two transverse strictures; lattice-work of the shell double or spongy.

The genus *Perispyris* differs from the preceding *Tricolospyris*, its ancestral form, in the development of a secondary outer shell, which encloses the inner primary one either like an enveloping cortical shell or like a spongy veil. This is produced by the concrescence of meeting branches, which arise from spines of the inner shell.

[1] *Perispyris* = Wicker-basket surrounded by an envelope; *περί, σπυρίς*.

1. *Perispyris bicincta*, n. sp. (Pl. 88, fig. 13).

Shell smooth, with two deep transverse annular strictures and a deep sagittal incision at the sternal base; one and a half times as long as broad. Cephalis nut-shaped, with large irregular roundish pores and very broad bars. Everywhere from its surface there arise numerous slender arborescent radial beams; by the anastomoses of their ramified branches there arise the flat cap-shaped cupola and the larger bilobed thorax; and also the external enveloping shell with loose delicate network.

*Dimensions.*—Inner shell 0·17 long, 0·1 broad; outer shell 0·23 long, 0·17 broad; ring 0·06 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Perispyris spongiosa*, n. sp.

Shell rough, with two distinct transverse strictures and a deep sternal incision, similar to the preceding; the radial beams arising from the inner shell, and forming by anastomosing branches the outer shell, are thinner and more numerous, and the framework of the latter on the surface is very dense and spongy, therefore the shell is dark and not transparent.

*Dimensions.*—Inner shell 0·18 long, 0·12 broad; outer shell 0·24 long, 0·18 broad; ring 0·08 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Perispyris lentellipsis*, n. sp. (Pl. 88, fig. 12).

Shell smooth, lentelliptical, with three different isopolar axes, perpendicular one to another. Transverse and sagittal strictures are wanting; but the large enclosed ring and the two pairs of large adjacent annular meshes indicate clearly the position and size of the hidden cephalis. The two other joints (the cupola on the upper and the thorax on the lower pole of the cephalis) are nearly equal, cap-shaped or hemispherical. The outer lentelliptical shell is little larger than the inner, connected with it by numerous thin bristle-shaped radial beams, and exhibits a delicate arachnoidal lattice-work.

*Dimensions.*—Inner shell 0·15 long, 0·1 broad; outer shell 0·18 long, 0·13 broad; ring 0·08 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Subfamily 3. Nephrospyrida (vel Paradictyida, Haeckel, 1881).

*Definition.*—Androspyrida without free basal feet and external constrictions. Shell either spherical or discoidal.

### Genus 484. *Sphærospyris*,[1] n. gen.

*Definition.*—Androspyrida with a spherical or subspherical shell, without basal incision and transverse constriction; without free basal feet.

[1] *Sphærospyris* = Spherical wicker-basket; σφαῖρα, σπυρίς.

The genus *Sphærospyris* differs from all other Spyroidea in the regular spherical or spheroidal form of the lattice-shell. It may therefore be easily confounded with some species of the Sphæroidea; but the internal sagittal ring, placed in the median plane of the fenestrated sphere and connected with it by radial beams, leaves no doubt that it is derived from a true Spyroid, either *Dictyospyris* or *Amphispyris*, or another genus. Sometimes also four larger collar pores are visible.

1. *Sphærospyris sphæra*, Haeckel.

*Dictyospyris sphæra*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 511, 539, Taf. xxxii. fig. 15, *a*, *b*.

Shell smooth, nearly spherical, slightly flattened at the base, with small regular circular pores. In the centre of the basal plate a regular rectangular cross with four equal collar pores.

*Dimensions.*—Diameter of the shell 0·11, of the enclosed ring 0·06.

*Habitat.*—Fossil in Barbados.

2. *Sphærospyris quddriforis*, n. sp.

Shell rough, nearly spherical, slightly flattened at the base, with small regular circular pores. In the centre of the basal plate a bilateral symmetrical cross with four ovate collar pores; two cardinal pores twice as large as the two jugular pores and six to eight times as broad as the other shell-pores.

*Dimensions.*—Diameter of the shell 0·26, of the enclosed ring 0·09.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

3. *Sphærospyris globosa*, n. sp. (Pl. 83, fig. 4).

Shell smooth, perfectly spherical, with small subregular circular pores. In the centre of the basal plate no larger collar pores. (The original collar pores are here of the same size as the other pores, and cannot therefore be distinguished.)

*Dimensions.*—Diameter of the shell 0·13, of the enclosed ring 0·06.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Genus 485. *Nephrospyris*,[1] Haeckel, 1881, Prodromus, p. 444.

*Definition*—Androspyrida with a discoidal, kidney-shaped, or subcircular shell, with a basal incision; without transverse constriction and free basal feet.

The genus *Nephrospyris* is one of the most peculiar and most modified of the Spyroidea, of extraordinary size, in this respect surpassing all other genera of this

[1] *Nephrospyris* = Kidney-shaped basket; νεφρός, σπυρίς.

suborder, and differing from them in its flat discoidal form. The diameter of the compressed shell often reaches one half millimetre or more; its perimeter is elliptical or nearly circular, smooth, constantly with a characteristic deep sternal incision or a basal sinus on the basal pole of the main axis. The central sagittal ring is comparatively small. The margin is often inflated, like a delicate reticular girdle, and contains a large number of peculiar spherical or roundish nucleated cells (Pl. 90, figs. 6–10). According to the observations of Dr. John Murray, made on living *Nephrospyris*, they are Vorticellina, perhaps constant Symbiontes.

Subgenus 1. *Nephrodictyum*, Haeckel, 1881, Prodromus, p. 444.

*Definition.*—Network of the shell simple, with bars of nearly equal breadth.

1. *Nephrospyris renilla*, n. sp. (Pl. 90, figs. 9, 10).

Shell kidney-shaped, one and a half times as broad as long, and three times as long as the deep kidney-shaped sternal incision. Ring with six pairs of branched apophyses, the bars of the apical pair vertical, of the basal pair divergent. The corresponding bars of the two middle pairs (on the frontal and the occipital face) form together on each side a large pentagonal or hexagonal naso-orbital area, which is surrounded by four or five large polygonal meshes; the other meshes become smaller towards the inflated margin. All meshes simple, without arachnoidal framework.

*Dimensions.*—Shell 0·3 to 0·4 long, 0·4 to 0·5 broad; ring 0·08 to 0·1 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Nephrospyris nephridium*, n. sp.

Shell kidney-shaped, one and two-third times as broad as long, very similar to the preceding species (or only a variety of it ?). Ring with seven pairs of branched apophyses. The large naso-orbital area is on the dorsal or occipital side simple, on the ventral or facial side divided by an equatorial pair of transverse horizontal branches into two superior orbital, and two inferior nasal holes. Sternal incision ovate. All meshes simple.

*Dimensions*—Shell 0·25 to 0·35 long, 0·4 to 0·5 broad; ring 0·07 to 0·08 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

3. *Nephrospyris phaseolus*, n. sp.

Shell kidney-shaped, twice as broad as long, very similar to the two preceding species (or only a variety of them ?). Ring with eight pairs of branched apophyses. The large naso-orbital area (between the mitral and collar ring) is on the dorsal and on the ventral side divided by two equatorial pairs of horizontal branches into two superior (orbital and occipital), and two inferior (nasal and suboccipital) holes. Sternal incision cordate. All meshes simple.

*Dimensions.*—Shell 0·25 long, 0·5 broad; ring 0·06 to 0·07 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

4. *Nephrospyris cordata*, n. sp.

Shell heart-shaped, about as long as broad. Ring with six pairs of branched apophyses (as in *Nephrospyris renilla*, Pl. 90, fig. 9). No equatorial transverse branches. Sternal incision cordate, deeper than in all other species of the genus, nearly half as long as the shell. All meshes of the network simple.

*Dimensions.*—Shell 0·32 long, 0·36 broad; ring 0·05 to 0·06 long.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

## Subgenus 2. *Paradictyum*, Haeckel, 1881, Prodromus, p. 444.

*Definition.*—Network of the shell double; the larger meshes separated by strong bars, and filled up by a very delicate secondary arachnoidal network.

5. *Nephrospyris paradictyum*, n. sp. (Pl. 90, figs. 1-8).

*Paradictyum paradoxum*, Haeckel, 1881, Prodromus et Atlas, *loc. cit.*

Shell nearly circular, ten times as broad as the inflated marginal girdle, and three times as long as the sternal incision. Ring with six pairs of branched apophyses; the bars of the apical pair nearly vertical, of the basal pair divergent; the corresponding and opposite bars of the two middle pairs (on the occipital and on the frontal face) form together a large middle naso-orbital area; above and below this lie six pairs of larger meshes. All larger meshes of the network are filled up by very delicate arachnoidal framework. The inflated and delicately reticulated marginal girdle of this and of the following closely allied species is usually filled up by nucleated roundish cells (fig. 7), which are Vorticellinæ, according to the observations of Dr. John Murray on living specimens.

*Dimensions.*—Diameter of the shell 0·5 to 0·6, of the marginal girdle 0·05 to 0·07; ring 0·07 to 0·09 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

6. *Nephrospyris paradoxa*, n. sp.

Shell kidney-shaped, one and one-third times as broad as long, six times as broad as the inflated marginal girdle, and half as long as the sternal incision. Ring with six pairs of apophyses. Above and below the large naso-orbital holes lie ten pairs of larger meshes. All the meshes are filled up by very delicate arachnoidal network.

*Dimensions.*—Length of the shell 0·4 to 0·5, breadth 0·5 to 0·7; ring 0·06 to 0·08 long.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

## Suborder II. BOTRYODEA, Haeckel, 1881 (Pl. 96).

*Polycyrtida*, Haeckel, 1862, Monogr. d. Radiol., p. 341.
*Polycyrtida*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 519.
*Botryodea* (=*Botrida* vel *Botryida*), Haeckel, 1881, Prodromus, p. 439.

*Definition.*—NASSELLARIA with a complete lattice-shell, exhibiting constantly a lobate and multilocular cephalis, with three to five or more separated lobes, and two to three or more constrictions.

The suborder Botryodea differs from the other Cyrtellaria in the multilocular and lobate shape of the cephalis, which is composed of at least three or four, often five or six, and sometimes even a greater number of lobes, which are separated by constrictions and partly also by internal septa. This characteristic shape is found neither in the Spyroidea (with bilocular cephalis) nor in the Cyrtoidea (with simple cephalis). The affinities of the former group to the two latter form a very complicated problem, which is not yet solved; the morphology of the Botryodea is the most difficult part in the system of NASSELLARIA, and what we can here give, are incomplete and unsatisfactory beginnings only.

Up to the year 1860 only a single genus of the Botryodea was known, *Lithobotrys*, one of the oldest genera of "*Polycystina*," and described by Ehrenberg in 1844 (Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 74). He gave the following definition:—"Loricæ siliceæ articuli in adulto non in seriem, sed in uvæ brevis formam, id est in loculos plus minus discretos nonnullos contiguos dispositi. Proxime ad Lithocampem accedit." In his first System (1847) *Lithobotrys* is placed with *Lithocampe* among his family Lithochytrina. Afterwards (1860) Ehrenberg added two new genera, under the names *Botryocampe* and *Botryocyrtis* and figured some species of these incompletely in his last works (1872, 1875).

In my Monograph I founded for these three genera the separate subfamily of Polycyrtida, added as a fourth genus *Spyridobotrys*, and gave to the group the following definition (1862, *loc. cit.*, p. 341):—"Lattice-shell divided by two or more annular strictures, partly longitudinally, partly transversely, into three or more unequal chambers, which are placed in different planes and have a different relation to the poles of the shell-axis."

The new and remarkable forms of Botryodea, which I subsequently found in the Challenger collection, demonstrated that the Botryodea differ from the other Cyrtellaria (the Cyrtoidea as well as the Spyroidea) in a far higher degree than I formerly had supposed. A synopsis of the figures in Pl. 96 will give sufficient evidence of this view. Therefore in my Prodromus (1881, p. 439)

I completely separated the Botryodea (or Botrida) from the other suborders of Cyrtellaria (Spyrida and Cyrtida).

Bütschli gave, in 1882, in his paper on the Cyrtida (*loc. cit.*) a very accurate description of *Lithobotrys geminata*, and pointed out its close affinity to *Lithocorythium* and *Lithomelissa*, and the importance of an oblique septum separating the cephalis into a smaller anterior and a larger posterior lobe. His views on the Botryodea (as a subordinate group of the Cyrtoidea) are however incomplete, since the peculiar forms, described in the following pages, were unknown to him.

According to the wide morphological divergence of the different Botryodea, and the numerous peculiar forms developed from it, we here divide the whole group into three families and ten genera, with fifty-five species. These form, however, only a small part of the large and varied mass of closely related forms which are found in the rich collections of the Challenger. The great difficulty of researches on their intimate structure, and the great amount of time required for it, prevented me from giving a more complete and exact description than the one here given. The observation of the small shells from all the different sides is a difficult task, requiring years of work, and its satisfactory explanation would be possible only by means of numerous figures.

The three families of Botryodea, here described, correspond to the three first groups of Cyrtoidea. The first family, Cannobotryida, corresponds to the Monocyrtida clausa and to the Zygospyrida; their shell consists of a cephalis only, without subsequent joints. The second family, Lithobotryida, corresponds to the Dicyrtida and Phormospyrida; their shell is composed of a cephalis and a thorax, both joints being separated by a transverse cortinar septum and a collar stricture. The third family, Pylobotryida, has a three-jointed shell, like the Tricyrtida, with cephalis, thorax and abdomen.

The cephalis is the most characteristic part of the shell of the Botryodea and its lobulate and multilocular shape separates them from the Spyroidea and Cyrtoidea. It represents the whole shell in the Cannobotryida, and in the young state of the two other families, which afterwards develop a thorax (Lithobotryida) and an abdomen (Pylobotryida). The typical lobulation of the cephalis is probably originally caused by internal septa; and these may be originated by branches of the internal columella, which corresponds either to the central ascending columella of the Plectoidea or to the excentric ascending dorsal rod of the sagittal ring of the Stephoidea. But afterwards, when the original septa disappear and are lost by reduction, only the external constrictions remain to indicate the limits of the single lobes.

Among the internal septa and the corresponding external constrictions which effect the lobulation of the cephalis, may be distinguished primary or constant septa and secondary or inconstant septa. As primary septa we regard firstly an oblique frontal

septum and secondly a vertical sagittal septum. The frontal septum (described accurately by Bütschli) has usually two or three pairs of pores and ascends obliquely from the base to the anterior face of the cephalis, where it is inserted in the orbital region; it divides the cephalis into a smaller anterior or facial lobe and a larger posterior or occipital lobe. The latter is commonly higher and more developed than the former and partly covers its upper face, like the crest of a helmet. The facial lobe is again bisected by an incomplete sagittal septum and a corresponding partial constriction on the anterior face. We find, therefore, in this original cephalis of the Botryodea, three primary lobes, an odd larger occipital lobe and two paired smaller facial lobes. The typical trilobed cephalis may be regarded perhaps as the common original form of the Botryodea.

The secondary and inconstant constrictions which we find in many Botryodea, and which produce a greater number of lobes in the cephalis, require further accurate observation. The following cases of lobation may be considered as the most important:—(1) Cephalis with four lobes, opposite in two pairs (two larger occipital and two smaller facial lobes, separated by a complete sagittal and an oblique frontal constriction); (2) cephalis with four unequal lobes, two of which are odd and sagittal, two paired and lateral (the odd occipital lobe usually larger and the odd mandibular lobe smaller than the two paired lateral or buccal lobes); (3) cephalis with five lobes (a large odd occipital lobe and two pairs of smaller lobes, anterior nasal, and lateral buccal lobes); (4) cephalis with five lobes, three of which are odd (a posterior occipital, middle frontal, and anterior facial lobe), and one pair of lateral lobes; (5) cephalis with six lobes, opposite in pairs (two larger occipital, two smaller nasal and two intermediate lateral or buccal lobes); (6) cephalis with six lobes, two of which are odd and sagittal (a large occipital and a smaller nasal lobe), four opposite in pairs (two anterior and two posterior buccal lobes); (7) cephalis with seven lobes, three of which are odd (a large posterior occipital, a middle frontal, and an anterior small nasal lobe), four opposite in two pairs (an anterior buccal and a posterior temporal pair); (8) cephalis with eight lobes, two of which are odd (a large posterior occipital and a small anterior frontal lobe) and six opposite in three lateral pairs; (9) cephalis with nine lobes, three of which are odd (an occipital, a frontal and a nasal lobe) and six opposite in three lateral pairs; (10) cephalis with ten lobes, two of which are odd (a large occipital and a smaller frontal lobe) and the other eight opposite in pairs; (11) cephalis with numerous lobes (twelve to fifteen or more) which are symmetrically disposed on each side of the median plane; (12) cephalis with numerous lobes (twelve to fifteen or more) which are irregularly and sometimes spirally conglomerated.

All these different forms of lobation require a far more thorough examination than I can devote to them, and may furnish examples of regular laws of development. The irregular forms are rather common, and I have found some very irregular Botryodea

(not here described) in which I could not determine the topographical regions of the cephalis. The difficulty in the examination of these complicated forms is increased by their very small size, which does not reach the usual dimensions of the other Cyrtellaria. In some cases I was able to observe on the base of the cephalis the same typical cortinar pores (in two or three pairs), which we also find in the same part of the cephalis in the Spyroidea and Cyrtoidea, and which are inherited from the Semantida.

The thorax of the Botryodea, or the second shell-joint, absent in the Cannobotryida, is usually of very simple form, ovate, truncate, conical or cylindrical, and consists of a secondary joint, developed from the base of the cephalis. The thorax is usually small, about the same size as the cephalis or a little larger, whilst in the Cyrtoidea it is commonly much larger than the latter. Its terminal mouth is closed by a lattice-plate in the Botryocellida, while it remains open in the Botryopylida and Pylobotryida.

The abdomen, or the third shell-joint, developed in the Pylobotryida only, generally also exhibits a very simple shape, like the thorax, and it is a tertiary joint developed from the base of the thorax. It exhibits to the latter the same relation as in the Tricyrtida. The terminal mouth of the abdomen remains open in the Botryocyrtida; it becomes closed by a lattice-plate in the Botryocampida.

The lattice-plate forming the shell of the Botryodea is usually very thin and fragile, with very small circular pores. These are often very numerous, at other times scarce, and sometimes nearly wanting, so that the shell appears hyaline. In this group there never occurs that great variety in form and size of the pores, which numerous Cyrtoidea and Spyroidea exhibit.

The radial apophyses which are found in the majority of Botryodea seem to correspond in position and relation to the typical radial beams of the other NASSELLARIA, viz., three descending basal feet arising from the base of the cephalis, and an ascending vertical apical horn arising from the top of the cephalis. Here also they seem to be inherited from the Plectoidea or Stephoidea (*Cortina*, *Cortiniscus*). But whilst these four typical radial beams in the other NASSELLARIA are usually simple spines or solid rods, here they usually appear as hollow cylindrical tubes, the thin wall of which is pierced by the same small pores as the shell. These porous tubes are either straight or slightly curved, often inflated and ovate at the base. We find in their number and disposition the same variety as in the simple radial spines of the other NASSELLARIA. The original number may here also be seen in the development of four typical beams, an ascending apical tube on the top of the cephalis, and three descending basal tubes on its base; the odd posterior tube of the latter corresponds to the caudal foot, the two paired anterior to the pectoral feet. There is often also a fourth foot developed opposite to the caudal, and representing a sternal tube. Sometimes also two superior tubes are developed, a posterior occipital and an anterior frontal. The different

apophyses may be lost by reduction. I have never observed Botryodea with more than five apophyses.

*The Central Capsule* of the Botryodea is not yet sufficiently known, no living species having been observed. In some preparations from specimens in the Challenger collections, stained by Dr. John Murray with carmine immediately after the dredging operation, single Botryodea are to be found in which the central capsule is deeply coloured. In *Botryopera quinqueloba* (Pl. 96, fig. 2) it filled up the greater part of the cephalis and seemed to be divided into some small lobes. In *Lithobotrys sphærothorax* (Pl. 96, fig. 15) it was divided into four lobes, three of which filled the trilobed cephalis, the fourth large lobe occupying a great part of the spherical thorax. Details of their structure, unfortunately, were not recognisable. There can, however, be no doubt that they are the same as in all other NASSELLARIA.

*Synopsis of the Families of* Botryodea.

| | |
|---|---|
| 1. Shell monothalamous, consisting of the lobate cephalis only, . . . | 1. CANNOBOTRYIDA. |
| 2. Shell dithalamous, composed of a lobate cephalis and a simple thorax, . | 2. LITHOBOTRYIDA. |
| 3. Shell trithalamous, composed of a lobate cephalis, a thorax and an abdomen, | 3. PYLOBOTRYIDA. |

## Family LVI. CANNOBOTRYIDA, Haeckel (*sensu emendato*).

*Cannobotryida*, Haeckel, 1881, Prodromus, p. 440.

*Definition.*—Botryodea monothalamia, the shell of which represents a lobate cephalis, without thorax and abdomen.

The family Cannobotryida (retained here with a stricter definition than originally was given in my Prodromus) comprises those Botryodea, in which the whole shell is represented by the cephalis alone, without thorax and abdomen. Since the two latter joints, found in the two following families, are secondary productions, the Cannobotryida must be regarded as the ancestral forms of all Botryodea, in an ontogenetic as well as in a phylogenetic sense.

Two species only of this family have been hitherto known, incompletely described by Ehrenberg as *Lithobotrys triloba* and *Lithobotrys quadriloba*. A great number of similar forms are to be found in the Radiolarian ooze of the Central Pacific, but they are very minute, and difficult to examine. We can describe here only twelve species of these, which we arrange in two genera; *Botryopera* without porous tubes, and *Cannobotrys* bearing a variable number of porous cylindrical tubes (one to five). The number of lobes of the cephalis is also variable in each genus (one to five or more). If in the future these minute and interesting shells should be better examined, it would

be advisable to distinguish a number of genera according to the different number of the porous tubes and of the lobes of the cephalis. The base of the latter is constantly closed by a basal lattice-plate, and usually exhibits two or three pairs of cortinar pores, identical with those of the Semantida.

The phylogenetic origin of the Cannobotryida may be found either in the Zygospyrida or in the Monocyrtida; they differ from these two similar groups in the lobation of the cephalis, which is effected by the development of internal septa and external constrictions.

*Synopsis of the Genera of Cannobotryida.*

| | |
|---|---|
| Cephalis without porous tubes, . . . . . | 486. *Botryopera.* |
| Cephalis with a variable number of porous tubes, . . . . . | 487. *Cannobotrys.* |

## Genus 486. *Botryopera*,[1] n. gen.

*Definition.*—Cannobotryida without tubes on the cephalis.

The genus *Botryopera* is the simplest form among the Botryodea, the shell consisting of a lobate cephalis only, without tubes or radial appendages. It may be derived either from *Dictyospyris* or from *Archicapsa* by development of the horizontal fold in the frontal face of the shell, and the corresponding internal frontal septum, which separates the larger occipital lobe from the smaller facial half; the latter may be divided again into paired frontal lobes, lateral buccal lobes, &c. *Botryopera* may be the common ancestral form of many Botryodea.

### 1. *Botryopera cyrtoloba*, n. sp. (Pl. 96, fig. 1).

Cephalis trilobate; the posterior odd occipital lobe helmet-shaped, about twice as large as the two paired anterior frontal lobes, which are subovate and covered by the upper half of the former. Pores small and numerous, subregular, circular; some larger pores at the base.

*Dimensions.*—Length of the shell 0·08, basal breadth 0·06.

*Habitat.*—Central Pacific, Station 265 to 274, depth 2350 to 2925 fathoms.

### 2. *Botryopera triloba*, Haeckel.

*Lithobotrys triloba*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 30.

Cephalis trilobate; the occipital lobe subcylindrical, one and a half times as long as the two frontal lobes, which are slender, ovate and not covered by the former. Pores small and numerous.

*Dimensions.*—Length of the shell 0·05, breadth 0·03.

*Habitat.*—Fossil in Tertiary rocks of the Mediterranean (Sicily, Greece, &c.)

[1] *Botryopera* = Basket with grapes; βότρυς, πήρα.

3. *Botryopera quadriloba*, Haeckel.

*Lithobotrys quadriloba*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 84.

Cephalis quadrilobate; the occipital lobe helmet-shaped, one and a half times as long as the two paired hemispherical buccal lobes, and twice as large as the anterior frontal lobe. Pores not numerous, rather large, circular.

*Dimensions.*—Length of the shell 0·06, breadth 0·04.

*Habitat.*—Fossil in Barbados and North America (Virginia).

4. *Botryopera quinqueloba*, n. sp. (Pl. 96, fig. 2).

Cephalis quinquelobate; the occipital lobe helmet-shaped, and twice as long as the two hemispherical frontal lobes, three times as long as the subspherical lateral buccal lobes. Pores scarce, small, circular.

*Dimensions.*—Length of the shell 0·07, basal breadth 0·05.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

5. *Botryopera multiloba*, n. sp.

Cephalis multilobate; the posterior odd occipital lobe ovate, and of about the same size as the anterior frontal half of the shell, which is clustered and divided into five to seven smaller lobes, an odd subspherical sternal lobe, and on each side of it two or three pairs of smaller subspherical lobes.

*Dimensions.*—Length of the shell 0·09, breadth 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

Genus 487. *Cannobotrys*,[1] Haeckel, 1881, Prodromus, p. 440.

*Definition.*—Cannobotryida with tubes on the cephalis.

The genus *Cannobotrys* differs from the preceding *Botryopera* in the development of hollow radial tubes, arising from the lobate cephalis in various numbers. According to their number the genus may be divided into various subgenera: (1) *Cannobotrantha* (*monocanna*) with a single apical tube; (2) *Cannobotrella* (*dicanna*) with two divergent tubes, an ascending apical and a descending sternal one; (3) *Cannobotrissa* (*tricanna*) with three tubes in the sagittal plane (an upper apical, a posterior caudal, and an anterior sternal); (4) *Cannobotromma* (*tetracanna*) with four radial tubes disposed like the four typical spines of *Cortina* (compare p. 950), and *Cannobotrusa* (*pentacanna*) with five radial tubes disposed like the five typical spines of *Stephanium* (p. 952).

[1] *Cannobotrys*=Grape with tubes; κάννα, βότρυς.

Perhaps these five groups may be separated as five genera, possessing near relations to five very different genera of NASSELLARIA (*Circospyris, Halicapsa, Archibursa, Cortina, Stephanium*, &c.

1. *Cannobotrys monocanna*, n. sp.

Cephalis trilobate, with a single cylindrical straight apical tube on the apex of the occipital lobe, which is helmet-shaped, and about one and a half times as long as the two subspherical frontal lobes. Pores small and numerous, subregular, circular.

*Dimensions.*—Length of the shell 0·05, breadth 0·03.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

2. *Cannobotrys dicanna*, n. sp.

Cephalis quadrilobate, with two divergent tubes, an odd apical tube on the apex of the posterior occipital lobe, and an odd sternal tube on the anterior frontal lobe. Between these two odd lobes lie two paired lateral or buccal lobes, of about the same size. Shell nearly hyaline, with very few minute pores.

*Dimensions.*—Length of the shell 0·06, breadth 0·04.

*Habitat.*—Indian Ocean; Madagascar (Rabbe), surface.

3. *Cannobotrys tricanna*, n. sp. (Pl. 96, fig. 3).

Cephalis quinquelobate, with three curved cylindrical tubes in the sagittal plane; an ascending apical tube on the apex of the helmet-shaped occipital lobe, and two horizontal tubes on the base of the shell (a posterior caudal, *c*, and an anterior sternal, *z*). The two frontal lobes are hemispherical, and twice as large as the two lateral buccal lobes. Pores very small and numerous.

*Dimensions.*—Length of the shell 0·08, basal breadth 0·06.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

4. *Cannobotrys sagittalis*, n. sp.

Cephalis multilobate, with three straight divergent cylindrical tubes in the sagittal plane; a vertical apical tube on the apex of the ovate occipital lobe, and two horizontal tubes on the base, as in the preceding similar species; it differs from the latter in the greater number of lobes (seven or nine), the two frontal lobes being divided into two or four secondary lobules.

*Dimensions.*—Length of the shell 0·1, breadth 0·07.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

5. *Cannobotrys cortina*, n. sp. (Pl. 96, fig. 4).

Cephalis quinquelobate, with four cylindrical nearly straight tubes of equal size; an ascending, nearly vertical, apical tube on the apex of the occipital lobe, and three divergent descending tubes

on the base of the shell (an odd posterior caudal tube and two paired anterior pectoral tubes). The two lateral buccal lobes are twice as large as the two anterior frontal lobes, and half as large as the posterior odd occipital lobe. The four tubes in this and the following species correspond probably to the four spines of *Cortina* (p. 950).

*Dimensions.*—Length of the shell 0·07, basal breadth 0·06.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

6. *Cannobotrys tetracanna*, n. sp.

Cephalis multilobate, with four cylindrical curved tubes conical at their wider base, corresponding to those of the preceding species and to the four spines of *Cortina*. The odd occipital lobe is of about the same size as the anterior part of the shell, which is cleft into three pairs of roundish lobes, one pair of anterior larger frontal lobes, and two pairs of smaller lateral buccal lobes. Pores very few and minute.

*Dimensions.*—Length of the shell 0·11, basal breadth 0·07.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

7. *Cannobotrys pentacanna*, n. sp.

Cephalis quinquelobate, with five cylindrical slender curved tubes, three of which are placed in the sagittal plane (a superior apical, a posterior caudal, and an anterior sternal), whilst the other two are paired and diverge laterally (two pectoral tubes). The five tubes correspond exactly to the five typical spines of *Stephanium* (p. 952). The helmet-shaped occipital lobe of the shell is twice as large as each of the two anterior frontal lobes, and three times as large as each of the two lateral buccal lobes. Pores numerous.

*Dimensions.*—Length of the shell 0·07, basal breadth 0·04.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Family LVII. LITHOBOTRYIDA, n. fam.

*Definition.*—Botryodea dithalamia, the shell of which is composed of a lobate cephalis and a simple thorax, without abdomen.

The family Lithobotryida comprises those Botryodea in which the shell is divided by a transverse annular constriction into a lobate cephalis and a simple thorax. They correspond therefore to the Dicyrtida among the Cyrtoidea, and to the Phormospyrida among the Spyroidea. The thorax, or the second shell-joint, is in all these three families a secondary production, arising from the base of the cephalis; therefore the Lithobotryida must be phylogenetically derived from the Cannobotryida.

Several species of *Lithobotrys* were first described by Ehrenberg as *Lithobotrys* and *Lithocorythium*. These two genera are, however, identical, as has been

demonstrated by Bütschli (1882, *loc. cit.*, p. 519). Some other species united by Ehrenberg with *Lithobotrys* belong to other genera. The number of Lithobotryida found in the "Radiolarian ooze" of the Challenger collection, is far greater than that of the Cannobotryida and Pylobotryida. But only a small part of them could be thoroughly examined and described here, so that their number may be greatly augmented by further accurate researches. We here arrange those forms in four genera, representing two different subfamilies. The terminal mouth of the thorax remains open in the Botryopylida, whilst it becomes closed by a lattice-plate in the Botryocellida. In each group there are shells with and without porous tubes. The number of these tubes, and also the number of lobes of the cephalis, is very variable, and may in future serve for the distinction of more genera.

*Synopsis of the Genera of Lithobotryida.*

| | | |
|---|---|---|
| I. Subfamily Botryopylida. Mouth of the thorax open. | Cephalis without porous tubes, . . . . | 488. *Botryopyle.* |
| | Cephalis with a variable number of porous tubes, | 489. *Acrobotrys.* |
| II. Subfamily Botryocellida. Mouth of the thorax closed by a lattice-plate. | Cephalis without porous tubes, . . . . | 490. *Botryocella.* |
| | Cephalis with a variable number of porous tubes, . . | 491. *Lithobotrys.* |

Genus 488. *Botryopyle*, Haeckel, 1881, Prodromus, p. 440.

*Definition.*—Lithobotryida without tubes on the cephalis, and with the mouth of the thorax open.

The genus *Botryopyle* comprises the simplest forms of Lithobotryida, the lobate cephalis bearing no tubes and the basal mouth of the thorax remaining open. It may be derived either from *Dictyocephalus* or from *Desmospyris*, by development of lobes on the cephalis and of an internal frontal septum, separating the larger occipital lobe from the smaller frontal half of the shell. The latter may be divided again into anterior frontal lobes, lateral buccal lobes, &c.

1. *Botryopyle sethocorys*, n. sp. (Pl. 96, fig. 7).

Cephalis trilobate, separated by a deep collar constriction from the hemispherical thorax, which is twice as broad. Occipital lobe helmet-shaped, little longer than the two hemispherical frontal lobes. Surface spiny. Pores irregular, roundish, of very different size.

*Dimensions.*—Length of the shell 0·1, breadth 0·07.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Botryopyle cribrosa*, Haeckel.

*Lithobotrys cribrosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iii. fig. 20.

? *Lithobotrys biceps*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 295, Taf. ix. fig. 23.

Cephalis trilobate, separated by a slight collar constriction from the ovate thorax, which is somewhat smaller. Occipital lobe very large, helmet-shaped, longer than the thorax and twice as long as the two subspherical frontal lobes. Pores regular, circular, scarce.

*Dimensions.*—Length of the shell 0·11, breadth 0·05.

*Habitat.*—Fossil in Barbados.

3. *Botryopyle cephalodes*, Haeckel.

*Lithocorythium cephalodes*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iv. fig. 6.

Cephalis quinquelobate, separated by a slight collar constriction from the larger conical thorax, which is gradually dilated towards the wide mouth. Occipital lobe helmet-shaped, little longer than the frontal half of the cephalis, which is divided into two pairs of lateral chambers, corresponding to the four crossed pores of the sagittal septum, figured by Ehrenberg. The figure of the latter is inverse, seen from the frontal face, a part of the frontal wall having been broken off.

*Dimensions.*—Length of the shell 0·08, breadth 0·05.

*Habitat.*—Fossil in Barbados.

4. *Botryopyle dictyocephalus*, n. sp. (Pl. 96, fig. 6).

Cephalis multilobate, separated by an oblique constriction from the subcylindrical thorax, which is somewhat larger and slightly curved. Occipital lobe conical, of the same length as the posterior part of the triangular frontal half of the shell, which is divided into five to seven lobes, two or three odd lobes in the median part, and one or two pairs of lateral lobes; very variable in size and form of the lobes. Mouth of the thorax wide, truncate.

*Dimensions.*—Length of the shell 0·12, breadth 0·07.

*Habitat.*—Central Pacific, Station 271 to 274, depth 2350 to 2750 fathoms.

5. *Botryopyle inclusa*, n. sp. (Pl. 96, fig. 5).

Cephalis multilobate, campanulate, separated by a sharp constriction from the inflated thorax, which is nearly twice as long and broad. Both joints of the shell are irregularly lobate, with numerous vaulted lobes of different sizes, and partly internal septa. Pores small and numerous.

*Dimensions.*—Length of the shell 0·1, breadth 0·06.

*Habitat.*—Mediterranean (Candia) Spratt, depth 1620 fathoms.

Genus 489. *Acrobotrys*, Haeckel,[1] 1881, Prodromus, p. 440.

*Definition.*—Lithobotryida with tubes on the cephalis, and with the mouth of the thorax open.

The genus *Acrobotrys* differs from the preceding *Botryopyle* in the development of radial tubes, and from its probable ancestral form, *Cannobotrys*, in the development of a thorax, the basal mouth of which remains open. According to the varying number of the tubes we may distinguish the following five subgenera (corresponding to those of *Cannobotrys*), viz., (1) *Acrobotrantha* (*monosolenia*) with a single (apical) tube; (2) *Acrobotrella* (*disolenia*) with two divergent tubes (an apical and a sternal); (3) *Acrobotrissa* (*trisolenia*) with three sagittal tubes (an apical, a caudal, and a sternal); (4) *Acrobotromma* (*tetrasolenia*) with four tubes, like the four typical spines of *Cortina*; and (5) *Acrobotrusa* (*pentasolenia*) with five feet, corresponding to the five typical spines of *Stephanium*.

1. *Acrobotrys monosolenia*, n. sp.

Cephalis trilobate, with a single straight apical tube, which ascends vertically from the apex of the occipital lobe, and is pointed at the distal end, with an anterior oblique aperture. Two frontal lobes paired, ovate, half as long as the helmet-shaped occipital lobe. Thorax ovate, twice as long as the cephalis. Pores very scarce.

*Dimensions.*—Length of the shell 0·08, breadth 0·06.

*Habitat.*—Mediterranean (Corfu), surface.

2. *Acrobotrys disolenia*, n. sp. (Pl. 96, fig. 10).

Cephalis trilobate, with three odd ovate lobes of nearly equal size in the sagittal plane and two divergent straight slender cylindrical tubes, a vertical apical tube on the occipital lobe, and a horizontal nasal tube on the frontal lobe; the middle lobe between them is somewhat smaller. Thorax ovate, about twice as large as the cephalis, with constricted mouth. Pores small and numerous.

*Dimensions.*—Length of the shell 0·1, breadth 0·06.

*Habitat.*—Central Pacific, Station 265 to 274, depth 2350 to 2925 fathoms.

3. *Acrobotrys aquaria*, n. sp.

Cephalis quinquelobate, with two divergent long cylindrical curved tubes. Occipital lobe helmet-shaped, with an ascending apical tube; nasal lobe conical, with a descending sternal tube;

[1] *Acrobotrys*=Perfect grape; ἀκρός, βότρυς.

between them a smaller odd middle lobe, and on each side of the latter an ovate frontal lobe. Thorax inflate, twice as long and broad as the cephalis. Pores small, scarce.

*Dimensions.*—Length of the shell 0·09, breadth 0·07.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

4. *Acrobotrys acuminata*, n. sp. (Pl. 96, fig. 9).

Cephalis sexlobate, with two divergent tubes. Occipital and frontal lobes ovate, odd; between them a cupola-shaped apical lobe, bearing an ascending pointed apical tube. On each side at the base a small buccal lobe, and between the paired buccal lobes an anterior nasal lobe with a descending curved sternal tube. Thorax smaller than the cephalis. Pores numerous and small.

*Dimensions.*—Length of the shell 0·11, breadth 0·09.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

5. *Acrobotrys auriculata*, n. sp. (Pl. 96, fig. 11).

Cephalis quadrilobate, with three pointed and auriculate tubes, two ascending apical (an anterior and a posterior) in the helmet-shaped occipital lobe, and a descending sternal tube on the base of the frontal lobe; between the lobes two lateral paired buccal lobes. Thorax campanulate, twice as broad as the cephalis. Pores rather large and numerous.

*Dimensions.*—Length of the shell 0·1, breadth 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

6. *Acrobotrys trisolenia*, n. sp. (Pl. 96, fig. 8).

Cephalis quadrilobate, with four odd lobes and three divergent curved tubes, an ascending apical tube in the conical occipital lobe, and two descending tubes on the anterior and posterior basal lobes; between these three lobes a small central lobe. Thorax ovate, about as large as the cephalis. Pores small and numerous.

*Dimensions.*—Length of the shell 0·11, breadth 0·05.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

7. *Acrobotrys tetrasolenia*, n. sp.

Cephalis trilobate, with four slender cylindrical tubes. Occcipital lobe helmet-shaped, with an apical tube on the apex and a caudal tube on the base. Two frontal lobes ovate, prolonged into two paired pectoral tubes. The four tubes correspond in position to the four spines of *Cortina*. Thorax inflate, ovate, larger than the cephalis. Pores very scarce, rather large, irregular.

*Dimensions.*—Length of the shell 0·08, breadth 0·05.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

8. *Acrobotrys pentasolenia*, n. sp.

Cephalis quinquelobate, with five short conical tubes; three divergent odd tubes arise from three odd lobes; an apical from the occipital lobe, a posterior caudal from the suboccipital lobe, and an

anterior sternal from the nasal lobe. Two paired lateral tubes arise from the base of two ovate frontal lobes. The five tubes correspond in disposition to the five spines of *Stephanium*. Thorax truncate. Pores small.

*Dimensions.*—Length of the shell 0·12, breadth 0·09.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Genus 490. *Botryocella*,[1] Haeckel, 1881, Prodromus, p. 440.

*Definition.*—Lithobotryida without tubes on the cephalis, and with the mouth of the thorax closed.

The genus *Botryocella* differs from the closely allied *Botryopyle* in having the mouth of the thorax closed, and may be derived from it by development of a lattice-plate, effecting this closure. It bears therefore the same relation to the latter that *Dicolocapsa* has to *Dictyocephalus*.

### 1. *Botryocella nucula*, Haeckel.

*Lithobotrys nucula*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iii. fig. 16.

*Lithobotrys adspersa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iii. fig. 15.

Cephalis trilobate; occipital lobe helmet-shaped, nearly twice as long as the two ovate frontal lobes. Thorax about as long as the cephalis. Pores very small and scarce.

*Dimensions.*—Length of the shell 0·06, breadth 0·03.

*Habitat.*—Fossil in Barbados.

### 2. *Botryocella borealis*, Haeckel.

*Lithobotrys borealis*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 294, Taf. ii. fig. 3.

Cephalis trilobate; occipital lobe ovate, little longer than the two ovate frontal lobes. Thorax about twice as long as the cephalis.. Pores very numerous and small.

*Dimensions.*—Length of the shell 0·08, breadth 0·04.

*Habitat.*—North Atlantic, Greenland, depth 1000 to 2000 fathoms.

### 3. *Botryocella tricellaris*, n. sp.

Cephalis trilobate, with three odd sagittal lobes; the middle or central lobe larger than the anterior frontal and smaller than the posterior occipital lobe. Thorax nearly spherical, about as long as the cephalis. Pores small and scarce.

*Dimensions.*—Length of the shell 0·08, breadth 0·06.

*Habitat.*—North Atlantic, Station 353, depth 2965 fathoms.

[1] *Botryocella*=Grape-pinnace; *βότρυς*, *κέλλα*.

4. *Botryocella quadricellaris*, n. sp. (Pl 96, fig. 13).

Cephalis quadrilobate; the helmet-shaped occipital lobe twice as long as the two paired subspherical buccal lobes, and three times as long as the odd spherical frontal lobe. Thorax nearly spherical, about as long as the cephalis.

*Dimensions.*—Length of the shell 0·1, breadth 0·05.

*Habitat.*—Central Pacific, Station 272, depth 4475 fathoms.

5. *Botryocella quadrigemina*, n. sp. (Pl. 96, fig. 14).

Cephalis quadrilobate, with two pairs of lateral ovate lobes and complete sagittal constriction; the two occipital lobes nearly twice as large as the two frontal lobes. Thorax ovate, separated from the cephalis by a collar septum with four cortinar pores (fig. 14).

*Dimensions.*—Length of the shell 0·09, breadth 0·06.

*Habitat.*—Indian Ocean, Sunda Strait (Rabbe), surface

6. *Botryocella multicellaris*, n. sp. (Pl. 96, fig. 12).

Cephalis multilobate; occipital lobe helmet-shaped, very large, about twice as long and broad as the frontal half of the shell, which is divided into six to eight small roundish clustered lobes. Thorax subspherical, of about the same size as the cephalis.

*Dimensions.*—Length of the shell 0·1, breadth 0·05.

*Habitat.*—South Pacific Station 297, depth 1775 fathoms.

Genus 491. *Lithobotrys*,[1] Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 74.

*Definition.*—Lithobotryida with tubes on the cephalis, and with the mouth of the thorax closed.

The genus *Lithobotrys*, the oldest and first known of the Botryodea, was founded by Ehrenberg in 1844, and was one of his five oldest genera of Polycystina. It represented by itself the suborder Botryodea until the year 1860. The numerous species described by Ehrenberg belong to very different genera of Botryodea, and partly also of Spyroidea. Following Bütschli (1882) we retain here the name *Lithobotrys* for those species, the type of which is *Lithobotrys geminata*. The genus *Lithocorythium* of Ehrenberg is for the greater part identical with it. When in the preceding genus *Acrobotrys* the mouth of the thorax becomes closed by lattice work, *Lithobotrys* arises. In the latter as well as in the former the number of tubes on the cephalis is different, and may characterise different subgenera.

[1] *Lithobotrys*=Stone grape; λίθος, βότρυς.

1. *Lithobotrys geminata*, Ehrenberg.

*Lithobotrys geminata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iii. fig. 19.

*Lithobotrys geminata*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 519, Taf. xxxiii. fig. 27, *a* to *c*.

? *Lithocorythium platylophus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iv. fig. 5.

Cephalis trilobate, with a single apical tube in the apex of the helmet-shaped occipital lobe, which is one and a half times as long as the two subspherical frontal lobes. Thorax ovate, one and a half times as long as the cephalis, with few small pores in six to eight transverse rows.

*Dimensions.*—Length of the shell 0·1, breadth 0·05.

*Habitat.*—Fossil in Barbados.

2. *Lithobotrys lithocorythium*, Haeckel.

*Lithocorythium oxylophus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iv. figs. 3, 4.

? *Lithopera oxystauros*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 6.

Cephalis trilobate, with a single apical horn or a pointed tube in the apex of the helmet-shaped occipital lobe, which is a little longer than the two ovate frontal lobes. Thorax ovate, about as long as the cephalis, with very numerous and small pores.

*Dimensions.*—Length of the shell 0·08, breadth 0·04.

*Habitat.*—Fossil in Barbados.

3. *Lithobotrys nasuta*, Ehrenberg.

*Lithobotrys nasuta*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iii. fig. 21.

Cephalis quadrilobate, with a single descending sternal or nasal tube on the base of the anterior or frontal lobe, which is half as long as the helmet-shaped occipital lobe and twice as large as the two lateral buccal lobes. Thorax ovate, twice as long as the cephalis. Pores rather large, circular.

*Dimensions.*—Length of the shell 0·11, broad 0·05.

*Habitat.*—Fossil in Barbados.

4. *Lithobotrys ornata*, Ehrenberg.

*Lithobotrys ornata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iii. fig. 18.

Cephalis quinquelobate, with two divergent ascending tubes, a posterior occipital and an anterior sternal or nasal tube. Occipital lobe campanulate, twice as large as the two frontal, and four times as large as the two buccal lobes. Thorax ovate, twice as long as the cephalis. Pores scarce and small. The specimen figured by Ehrenberg is very incomplete.

*Dimensions.*—Length of the shell 0·09, breadth 0·05.

*Habitat.*—Fossil in Barbados.

5. *Lithobotrys sphærothorax*, n. sp. (Pl. 96, fig. 15).

Cephalis trilobate, with two divergent cylindrical tubes, an ascending apical tube in the apex of the ovate occipital lobe, and a descending sternal or nasal tube in the campanulate frontal lobe; between the two lobes a smaller central lobe. Thorax spherical, twice as long as the latter. Pores very small, numerous.

*Dimensions.*—Length of the shell 0·08, breadth 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4575 fathoms.

6. *Lithobotrys mascula*, n. sp. (Pl. 96, fig. 16).

Cephalis sexlobate, with two divergent cylindrical tubes, an ascending apical tube in the apex of the helmet-shaped occipital lobe and a descending sternal tube on the base, between the two kidney-shaped frontal lobes. The latter are half as large as the odd occipital lobe and of about the same size as the two inflated lateral buccal lobes, which are separated by a small odd nasal lobe.

*Dimensions.*—Length of the shell 0·13, breadth 0·08.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

7. *Lithobotrys orchidea*, n. sp. (Pl. 96, fig 17).

Cephalis sexlobate, similar to the preceding species, but with five divergent and curved cylindrical tubes, which correspond to the five spines of *Stephanium;* an apical tube on the apex of the occipital lobe, a caudal tube on its base, a sternal tube between the two frontal lobes, and two paired pectoral tubes between the latter and the lateral buccal lobes. Pores small and scarce.

*Dimensions.*—Length of the shell 0·12, breadth 0·06.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Family LVIII. PYLOBOTRYIDA, Haeckel (*sensu emendato*).

*Pylobotryida*, Haeckel, 1881, Prodromus, p. 440.

*Definition.*—Botryodea trithalamia, the shell of which is composed of a lobate cephalis, a thorax, and an abdomen.

The family Pylobotryida comprises those Botryodea in which the shell exhibits two parallel transverse annular constrictions, and is divided by these into three successive joints, corresponding to the cephalis, the thorax, and the abdomen of the Tricyrtida. As in the latter, the abdomen is here also a later production, arising from the terminal mouth of the thorax; therefore the Pylobotryida must be derived phylogenetically from the Lithobotryida.

Two genera of Pylobotryida were incompletely described in 1860 by Ehrenberg, *Botryocyrtis* and *Botryocampe*. We retain them here, with a stricter definition, however. Two other genera were added in my Prodromus—*Pylobotrys* and *Phormobotrys*.

The small number of species here enumerated may be easily increased, since numerous forms, belonging probably to this family, are not sufficiently known. Their study is, however, very difficult and requires accurate examination of the tiny shells from different sides.

The four genera of Pylobotryida, here described, represent two different subfamilies. The terminal mouth of the abdomen remains open in the Botryocyrtida, whilst it becomes closed by a lattice-plate in the Botryocampida. There are in both groups shells with and without porous tubes; the number of these tubes, and also the number and disposition of the lobes in the cephalis, exhibit remarkable differences in the different species of those genera, and may in future serve for their division into a greater number of genera.

*Synopsis of the Genera of Pylobotryida.*

| | | |
|---|---|---|
| I. Subfamily Botryocyrtida. Mouth of the abdomen open. | Cephalis without porous tubes, . . . | 492. *Botryocyrtis.* |
| | Cephalis with a variable number of porous tubes, . | 493. *Pylobotrys.* |
| II. Subfamily Botryocampida. Mouth of the abdomen closed by a lattice-plate. | Cephalis without porous tubes; . . . | 494. *Botryocampe.* |
| | Cephalis with a variable number of porous tubes, . | 495. *Phormobotrys.* |

Genus 492. *Botryocyrtis*,[1] Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 829.

*Definition.*—Pylobotryida without tubes on the cephalis, and with the mouth of the abdomen open.

The genus *Botryocyrtis*, founded by Ehrenberg upon two Indian species, is the simplest among the Pylobotryida. It may have been derived from *Botryopyle* by the development of an abdomen (or a third shell-joint), the mouth of which remains open.

1. *Botryocyrtis serpentis*, Ehrenberg.

*Botryocyrtis serpentis*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. x. fig. 21.

Cephalis quadrilobate; the odd frontal and the two paired buccal lobes subspherical, about half as large as the odd occipital lobe. Thorax inflated, about as long as the cephalis and half as long as the ovate abdomen. Mouth of the latter constricted, of half the breadth.

*Dimensions.*—Length of the shell 0·12, breadth 0·06.

*Habitat.*—Indian Ocean (Zanzibar), depth 2200 fathoms, Pullen.

[1] *Botryocyrtis*=Basket with grapes; *βότρυς*, *κυρτίς*.

2. *Botryocyrtis theocampe*, n. sp. (Pl. 96, fig. 19).

Cephalis quadrilobate; the odd frontal and the two paired buccal lobes hemispherical, about half as large as the helmet-shaped occipital lobe. Thorax cylindrical, of equal length and breadth, one and a half times as broad as the cephalis and as the cylindrical abdomen. Pores rather large, irregular, roundish.

*Dimensions.*—Length of the shell 0·12, breadth 0·06.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

3. *Botryocyrtis cerebellum*, n. sp. (Pl. 96, fig. 18).

Cephalis quinquelobate; the odd frontal and the two paired buccal lobes ovate, about half as large as the two helmet-shaped paired occipital lobes (?). Thorax campanulate, twice as broad and long as the cephalis and as the truncate cylindrical abdomen.

*Dimensions.*—Length of the shell 0·12, breadth 0·08.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

4. *Botryocyrtis quinaria*, Ehrenberg.

*Botryocyrtis quinaria*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. x. fig. 16.

Cephalis quinquelobate; the odd occipital lobe ovate, twice as large as each of the other four subspherical lobes, the two anterior (or frontal) of which are somewhat smaller than the two posterior (or buccal). Thorax campanulate, somewhat larger than the truncate abdomen. Pores rather large, irregular.

*Dimensions.*—Length of the shell 0·09, breadth 0·05.

*Habitat.*—Indian Ocean (Zanzibar and Madagascar), surface.

## Genus 493. *Pylobotrys*,[1] Haeckel, 1881, Prodromus, p. 440.

*Definition.*—Pylobotryida with tubes on the cephalis, and with the mouth of the abdomen open.

The genus *Pylobotrys* differs from the closely allied *Acrobotrys*, its ancestral form, in the development of an abdomen or a third shell-joint, the basal mouth of which remains open.

1. *Pylobotrys putealis*, n. sp. (Pl. 96, fig. 21).

Cephalis multilobate, with a single curved and descending tube on the base of its anterior part (sternal tube). Occipital half of the cephalis divided into three large odd lobes (the largest

[1] *Pylobotrys*=Grape with an aperture; πύλη, βότρυς.

the apical); facial half divided into three to five lobes, an odd frontal and one or two lateral pairs of small buccal lobes. Thorax truncate conical, about as large as the cephalis and larger than the truncate abdomen. Pores regular circular.

*Dimensions.*—Length of the shell 0·12, breadth 0·08.

*Habitat.*—Tropical Atlantic Station 347, depth 2250 fathoms.

2. *Pylobotrys fontinalis*, n. sp. (Pl. 96, fig. 20).

Cephalis trilobate, with three ovate lobes in the sagittal plane, of nearly equal size, and two divergent cylindrical tubes conical at the base. An ascending apical tube on the apex of the occipital lobe and a descending sternal tube on the base of the frontal lobe. The middle lobe between the former distinctly exhibits in the apical view (fig. 20) the collar septum with the four cortinar pores. Thorax campanulate, larger than the cephalis and the truncate abdomen.

*Dimensions.*—Length of the shell 0·11, breadth 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

3. *Pylobotrys cerebralis*, n. sp. (Pl. 96, fig. 22).

Cephalis multilobate, with four divergent cylindrical tubes, which are cylindrical, obliquely truncate at the mouth, and correspond in position to the four typical spines of *Cortina;* an ascending apical tube and three descending basal tubes (an odd caudal and two paired pectoral). The helmet-shaped occipital lobe is about as large as the frontal half of the cephalis, which is divided into three pairs of smaller pyriform lobes. Thorax subspherical, about as large as the cephalis and half as large as the inflated abdomen. Pores very scarce and small.

*Dimensions.*—Length of the shell 0·15, breadth 0·08.

*Habitat.*—Indian Ocean, Cocos Islands, Rabbe, surface.

## Genus 494. *Botryocampe*,[1] Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 829.

*Definition.*—Pylobotryida without tubes on the cephalis, and with the mouth of the abdomen closed.

The genus *Botryocampe* may be derived from *Botryocyrtis* by development of a basal lattice-plate, closing the terminal mouth of the abdomen. It is at the same time closely allied to the Tricyrtid *Theocapsa*, and may be perhaps derived from this by lobation of the cephalis.

[1] *Botryocampe*=Caterpillar with a grape; βότρυς, κάμπη

### 1. *Botryocampe inflata*, Ehrenberg.

*Botryocampe inflata*, Ehrenberg, 1861, Monatsber. d. k. Akad. d. Wiss. Berlin, p. 296; Abhandl. d. k. Akad. d. Wiss. Berlin, 1872, p. 285, Taf. ii. fig. 4.
*Botryocampe inflata*, Haeckel, 1862, Monogr. d. Radiol., p. 345.
*Lithobotrys inflata*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. p. 1, pl. i. fig. 15.

Cephalis trilobate, inflated, of about the same breadth and length as the tun-shaped thorax and the hemispherical abdomen. Frontal lobes of the cephalis ovate, a little smaller than the ovate odd occipital lobe. Pores numerous and small.

*Dimensions.*—Length of the shell 0·05 to 0·08, breadth 0·02 to 0·04.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, Stations 267 to 274, 241, 354, &c., surface, and in various depths.

### 2. *Botryocampe theocapsa*, n. sp.

Cephalis trilobate, half as long as the campanulate thorax, and one-third as long as the ovate abdomen. Frontal lobes subspherical, scarcely half as long as the helmet-shaped occipital lobe. Pores very small and scarce.

*Dimensions.*—Length of the shell 0·12, breadth 0·04.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

### 3. *Botryocampe galea*, Haeckel.

*Lithobotrys galea*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 83.
*Lithocorythium galea*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 29, *a*, *b*.
*Lithocorythium galea*, Haeckel, 1862, Monogr. d. Radiol., p. 330.

Cephalis quinquelobate, about as large as the ovate thorax, and twice as large as the hemispherical abdomen (which is identical with the "crista obtusa finis anterioris" of Ehrenberg). Occipital lobe helmet-shaped, about twice as long as the two pairs of lateral lobes (the superior frontal and the inferior buccal lobes).

*Dimensions.*—Length of the shell 0·08, breadth 0·04.

*Habitat.*—Fossil in Barbados.

### 4. *Botryocampe rotalia*, n. sp. (Pl. 96, fig. 23).

Cephalis quinquelobate, half as large as the campanulate thorax and the subspherical abdomen. Occipital lobe ovate, one and a half times as long as the two ovate frontal lobes, and three times as long as the two subspherical buccal lobes. Collar septum with six distinct cortinar pores (two anterior jugular, two middle cardinal and two posterior cervical, fig. 23).

*Dimensions.*—Length of the shell 0·1, breadth 0·06.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

5. *Botryocampe camerata*, n. sp. (Pl. 96, fig. 24).

Cephalis multilobate, about as long and half as broad as the irregularly campanulate thorax, which is half as long as the subspherical large abdomen. Occipital lobe of the cephalis helmet-shaped, larger than its uviform frontal part, which is divided into six to eight small subspherical lobes. In the interior of the thorax and abdomen irregularly branched rods are visible, which divide their inner space into compartments or incomplete chambers. Pores large, regular, circular, hexagonally framed.

*Dimensions.*—Length of the shell 0·15, breadth 0·09.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 495. *Phormobotrys*,[1] Haeckel, 1881, Prodromus, p. 440.

*Definition.*—Pylobotryida with tubes on the cephalis, and with the mouth of the abdomen closed.

The genus *Phormobotrys* differs from the similar and closely allied *Pylobotrys* in the development of a basal lattice-plate closing the terminal mouth of the thorax, and corresponds therefore to *Lithobotrys* among the Lithobotryida. As in the latter and in *Cannobotrys*, &c., so here in *Phormobotrys*, different subgenera may be distinguished, according to the different number and disposition of the radial tubes which become developed from the lobate cephalis.

1. *Phormobotrys trithalamia*, n. sp. (Pl. 96, fig. 26).

Cephalis trilobate, with a single apical tube, which is only one-third as long, spindle-shaped, pointed, with frontal opening. Frontal lobes ovate, two-thirds as long as the helmet-shaped occipital lobe. Internal frontal septum of the cephalis with four large pores. Thorax cylindrical, twice as long as the hemispherical abdomen. Pores small and numerous, irregular, roundish.

*Dimensions.*—Length of the shell 0·16, breadth 0·05.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Phormobotrys pentathalamia*, n. sp. (Pl. 96, fig. 27).

Cephalis quinquelobate, with a single conical apical tube of the same length, which has an obliquely truncate frontal opening. Odd frontal and paired buccal lobes smaller than the sternal and the occipital lobe. Internal frontal septum with six large pores. Thorax inflated, a little larger than the subspherical abdomen. Pores subregular, circular.

*Dimensions.*—Length of the shell 0·15, breadth 0·08.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

[1] *Phormobotrys* = Grape basket; φόρμος, βότρυς.

3. *Phormobotrys hexathalamia*, Haeckel.

*Botryocampe hexathalamia*, Haeckel, 1862, Monogr. d. Radiol., p. 344, Taf. xii. fig. 10.

Cephalis sexlobate, with a single apical horn, which is solid, vertical, cylindrical, pointed, only one-third as long. Frontal lobes subcylindrical, nearly as long as the kidney-shaped occipital lobe, three to four times as long as the small buccal lobes and the odd sternal lobe. Thorax tun-shaped, smaller than the cephalis, larger than the hemispherical abdomen. Pores numerous, subregular, circular.

*Dimensions.*—Length of the shell 0·13 to 0·15, breadth 0·05 to 0·06.

*Habitat.*—Mediterranean, Messina, surface.

4. *Phormobotrys cannothalamia*, n. sp. (Pl. 96, fig. 25).

Cephalis trilobate, of about the same breadth and length as the campanulate thorax, which is three times as long as the flat cap-shaped abdomen. The middle (or central) lobe of the cephalis is simple, nearly cubical, and smaller than the ovate occipital and frontal lobe. The two latter are prolonged into two slender cylindrical divergent tubes. Pores small and very numerous.

*Dimensions.*—Length of the shell 0·1, breadth 0·05.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

5. *Phormobotrys polythalamia*, n. sp.

Cephalis multilobate, of the same length and breadth as the subspherical thorax, and half as long as the ovate abdomen. Occipital lobe helmet-shaped, about as large as the frontal half of the cephalis, which is divided into six to eight lobes (two odd and two or three pairs of lateral lobes). Four cylindrical tubes corresponding to the four typical spines of *Cortina*, an ascending apical and three descending basal tubes (a posterior caudal and two anterior pectoral).

*Dimensions.*—Length of the shell 0·14, breadth 0·08.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

Suborder III. CYRTOIDEA, Haeckel, 1862.

*Cyrtida*, Haeckel, 1862, Monogr. d. Radiol., pp. 272, 280.
*Cyrtoidea* vel *Cyrtida*, Haeckel, 1881, Prodromus, pp. 425–439.
*Polycystina solitaria*, Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, pp. 53, 54.
*Monodictya nassellaria*, Ehrenberg, 1875, Abhandl. d. k. preuss. Akad. d. Wiss. Berlin, pp. 156, 157.

*Definition.*—NASSELLARIA with a complete lattice-shell, exhibiting a simple or reduced cephalis, which is neither bilocular nor lobate, without sagittal constriction.

The order Cyrtoidea, described by me in 1862 as the family Cyrtida, is by far the largest of all the main groups of Radiolaria, and remarkable from the extraordinary variety of forms and the number of species. In the following system more than eleven hundred species are described, comprising about one-fourth of the number of species in the whole class of Radiolaria. This astonishing variety, however, is not effected by development of a large number of different types, but by an extraordinary variability within certain restricted boundaries, similar to what is seen among insects and birds. The number of genera, therefore, is comparatively small, and they may all be disposed into four families only, which in my Monograph (1862, p. 280) were distinguished as Monocyrtida, Dicyrtida, Tricyrtida and Stichocyrtida. If we divide these four groups in the following pages into twelve families and twenty-four subfamilies, we are guided by practical considerations only, hoping thereby to give a better survey of the difficult labyrinth of Cyrtoidean morphology.

The Cyrtoidea are characterised by this wonderful richness of specific forms not only in the present seas, but also for millions of years in the former ages of our globe. The majority of all the fossil Radiolaria which are now known belong to this group, and many species of it are so common, that great rocks are formed by their union. This fact was first observed by Ehrenberg, who in his first system of *Polycystina* (1847, *loc. cit.*, p. 54) enumerated forty-four genera and two hundred and eighty-two species; the Cyrtoidea, his Polycystina solitaria, form the preponderant majority of the whole class, viz., twenty-five genera and one hundred and ninety-three species.

In this first system (of 1847), as well as in the last systematic table of Ehrenberg (of 1875, *loc. cit.*), the Cyrtida as "Polycystina solitaria" are opposed to all other Radiolaria, as "Polycystina composita." The former bear the definition "Testæ siliceæ spatio interno ample pervio, aut passim levius transverse constricto"; the latter, however, "Testæ siliceæ spatio interno celluloso aut strictura longitudinali constricto." In reality these definitions are insufficient, and the conclusions which Ehrenberg derived

from the organisation of the Polycystina solitaria and composita, were quite erroneous. So also are the definitions of the three families into which he divided the Polycystina solitaria, afterwards (in 1875) called by him "Monodictya nassellaria." These three families were the Halicalyptrina, Lithochytrina and Eucyrtidina. With these were also united the three genera of Botryodea known to Ehrenberg (*Lithobotrys, Botryocampe, Botryocyrtis*). We entirely separate these here from the true Cyrtida, on account of their lobate or multilocular cephalis.

Whilst Ehrenberg only knew the skeleton of the Polycystina solitaria, the first observations of living Cyrtida were published by Johannes Müller, 1858, in his fundamental treatise. He gave the first description and figures of the central capsule of this group, with the characteristic lobes developed from its basal part; and of the pseudopodia radiating on all sides (*loc. cit.*, Taf. vi.). The forms described by him were all Mediterranean, one Dicyrtid (*Lithomelissa mediterranea*), two Tricyrtids (*Eucyrtidium zancleum* and *Pterocanium charybdeum*), and one Stichocyrtid (*Lithocampe tropeziana*).

In my monograph (1862, p. 272–341) I gave a detailed description of all known and some new Cyrtida, and characterised this family by the fundamental monaxonial form of the shell, with two different poles (an upper apical and a lower basal pole), and by the unipolar growth, beginning from the apical pole. I pointed out also the peculiar structure of the monaxonial central capsule. At that time I divided the Cyrtida into five subfamilies, in which, however, the Spyroidea (=Zygocyrtida), and the Botryodea (=Polycyrtida) were united with the true Cyrtoidea (Monocyrtida, Dicyrtida, Stichocyrtida).

The astonishing number of new and interesting forms of Cyrtida which I found in the rich collection of the Challenger (beginning from 1876), and mainly in the Radiolarian ooze of the Central Pacific (Stations 263 to 274), enabled me to give in my Prodromus, in 1881, a greatly enlarged and amended system of this important group. I separated there the Spyroidea (=Zygocyrtida), and the Botryodea (=Polycyrtida) from the true Cyrtoidea by restricted definition, pointing out the essential differences in the structure of the cephalis in these groups of Cyrtellaria. The latter name, as here used, is therefore identical with the "Cyrtida" of my Monograph. In the Prodromus I divided the true Cyrtida (p. 426) into five subfamilies and thirty tribes, corresponding to the differences in the number of the shell-joints and of the radial apophyses, and in the shape of the closed or open mouth. These groups are here retained, but reduced to four families and twenty-four subfamilies, since the Tetracyrtida are better united with the Stichocyrtida (compare below).

Richard Hertwig in his work Organismus der Radiolarien (1879, pp. 74 to 86) gave the first accurate description of the finer structure of the central capsule of the Cyrtida, and pointed out their character as true Monopylea, with porochora and

podoconus, and the peculiar shape of its nucleus. He also published excellent figures of some interesting new species.

O. Bütschli, 1882, in his valuable paper entitled: "Beiträge zur Kentniss der Radiolarien-Skelette, insbesondere der der Cyrtida" (Zeitschr. für wiss. Zool., vol. xxxvi. p. 485) made an attempt at a natural classification of the Cyrtida, which he derived from the Spyroidea or Zygocyrtida. As already mentioned above, we cannot accept this essay as the foundation of a true natural system, since the affinities of the Cyrtellaria (and of the NASSELLARIA as a whole) are far more complicated and difficult than Bütschli supposed. His views were supported by accurate observations only on the structure of the fossil Cyrtoidea of Barbados; these, however, represent the minority only of the genera, and many interesting and important forms (mainly of true "Monocyrtida") remained unknown to Bütschli. A great part, however, of his observations are very useful, and his remarks on comparative morphology are very suggestive.

The Cyrtoidea may be divided into families and subfamilies according to three different principles, viz., (1) the number of joints into which the shell is divided by transverse strictures; (2) the number of radial apophyses which arise from the shell; (3) the shape of the basal mouth, which is either open or closed by a lattice-plate. At present every attempt of classification in this large group must be more or less artificial, since the affinities of the numerous smaller and larger groups are extremely complicated, and the ontogeny, the only sure guide in this phylogenetical labyrinth, is perfectly unknown. It seems therefore the most convenient to employ for our artificial classification, first, the number of shell-joints, second, the radial structure, and third, the shape of the mouth.

A. The number of joints into which the shell is divided by transverse constrictions, serves here for the distinction of four primary groups or suborders of the Cyrtoidea, viz., (1) Monocyrtida with one joint; (2) Dicyrtida with two joints; (3) Tricyrtida with three joints; and (4) Stichocyrtida with four or more joints. In my Prodromus (1881, p. 426) I divided the latter group into Tetracyrtida (with four joints), and Stichocyrtida (with five or more joints); but these two groups may be united, since the fourth and all the succeeding joints are of rather indifferent shape and of little morphological value. The three first joints, however, are usually very different and possess a high morphological importance, so that we distinguish the first joint as cephalis, the second as thorax, and the third as abdomen. The uppermost transverse constriction, which separates the two first joints, cephalis and thorax, is the collar stricture and is usually caused by an internal fenestrated septum, the cortinar septum. The second constriction, which separates the second and third joints (thorax and abdomen) is called the lumbar constriction. The following constrictions (in the Stichocyrtida) are indifferent and of little morphological interest, and require therefore no peculiar designation.

B. The radial structure, indicated by radial apophyses arising from the shell, offers three principal differences, according to which the whole group of Cyrtoidea may be divided into three large groups or sections, viz., (1) Pilocyrtida, or Cyrtoidea triradiata, with three radial apophyses; (2) Astrocyrtida, or Cyrtoidea multiradiata, with numerous radial apophyses (four to nine or more); and (3) Corocyrtida, or Cyrtoidea eradiata, without external radial apophyses. The majority of Cyrtoidea are Pilocyrtida, with three radial apophyses, which are probably homologous to the three primary feet of the Plectoidea and of *Cortina* (therefore "cortinar feet"). The Astrocyrtida, or the Cyrtoidea with a variable number of radial apophyses (at least four to six) may be derived from the Pilocyrtida by interpolation of secondary or interradial apophyses between the three primary or perradial apophyses. The Corocyrtida, however, or the Cyrtoidea without external radial apophyses, may have originated by reduction and loss of the latter, either from the Pilocyrtida or from the Astrocyrtida.

C. The shape of the basal mouth in the Cyrtoidea exhibits two essential differences only, viz., (1) the terminal mouth of the shell is a simple wide opening in the Stomocyrtida, or (2) the terminal mouth is closed by a lattice-plate, in the Clistocyrtida. As these two different cases occur in all the twelve families, which we have distinguished according to the differences in the number of joints and in the radial structure, we get altogether twenty-four subfamilies which are synoptically arranged in the following table:—

| Synopsis of the four sections, twelve families and twenty-four subfamilies of CYRTOIDEA. | PILOCYRTIDA. Cyrtoidea triradiata. (Three radial apophyses.) | | ASTROCYRTIDA. Cyrtoidea multiradiata. (Four to nine or more apophyses.) | | COROCYRTIDA. Cyrtoidea eradiata. (No radial apophyses.) | |
|---|---|---|---|---|---|---|
| Mouth of the shell. | *Aperta.* | *Clausa.* | *Aperta.* | *Clausa.* | *Aperta.* | *Clausa.* |
| MONOCYRTIDA. (Cyrtoidea monothalamia). | TRIPOCALPIDA. | | PHÆNOCALPIDA. | | CYRTOCALPIDA. | |
| | Archipilida. | Archiperida. | Archiphormida. | Archiphænida. | Archicorida. | Archicapsida. |
| DICYRTIDA. (Cyrtoidea dithalamia). | TRIPOCYRTIDA. | | ANTHOCYRTIDA. | | SETHOCYRTIDA. | |
| | Sethopilida. | Sethoperida. | Sethophormida. | Sethophænida. | Sethocorida. | Sethocapsida. |
| TRICYRTIDA. (Cyrtoidea trithalamia). | PODOCYRTIDA. | | PHORMOCYRTIDA. | | THEOCYRTIDA. | |
| | Theopilida. | Theoperida. | Theophormida. | Theophænida. | Theocorida. | Theocapsida. |
| STICHOCYRTIDA. (Cyrtoidea polythalamia). | PODOCAMPIDA. | | PHORMOCAMPIDA. | | LITHOCAMPIDA. | |
| | Stichopilida. | Stichoperida. | Stichophormida. | Stichophænida. | Stichocorida. | Stichocapsida. |

The cephalis, or the first shell-joint of the Cyrtoidea, is in the majority homologous with the cephalis of the Spyroidea, from which it differs in the reduction of the sagittal ring and the absence of the corresponding sagittal constriction; its cavity is therefore simple, not bilocular. Its homology with the original cephalis of the Spyroidea cannot be doubted, when its base exhibits the typical basal pores of the Semantida. But in many cases these are wanting, and in a great number of Cyrtoidea (mainly of Monocyrtida) there is more or less evidence that the original cephalis is lost, and that the real first joint is the thorax, the original second joint. At present it is quite impossible to distinguish between the former and the latter shells, and therefore in the following descriptions the first joint is always named cephalis and the second thorax. In future, when the affinities of the Cyrtoidea become better known, it will be necessary to distinguish the "Archicephalis," or the true cephalis of all Spyroidea and of the majority of Cyrtoidea, from the "Pseudocephalis" or the false cephalis of the minority (*e.g.*, of many Monocyrtida aperta, Archipilida, Archiphormida, Archicorida, &c.).

The thorax, or the second shell-joint of the Cyrtoidea, is in the majority homologous with the thorax of the Phormospyrida and Androspyrida, and therefore developed by apophyses, which arise from the base of the cephalis and become united by transverse branches forming a lattice-plate. Its size is generally in inverse proportion to that of the cephalis. The more the cephalis becomes reduced, the more the thorax is developed. Its form is very variable, usually three-sided pyramidal or prismatic in the triradiate, polyhedral in the multiradiate, and conical or cylindrical in the eradiate Cyrtoidea. Its terminal mouth is either a simple wide opening, or closed by a lattice-plate. In the majority of Cyrtoidea the thorax is separated from the cephalis not only by the external collar constriction, but also by the internal cortinar septum, a horizontal lattice-plate which exhibits the typical basal pores of the Semantida (usually two smaller jugular and two larger cardinal pores). But this septum is often reduced or perfectly lost, and then the external collar constriction alone indicates the separation of the cephalis and the thorax.

The abdomen, or the third shell-joint of the Cyrtoidea, absent in the Monocyrtida and Dicyrtida (as also in all Spyroidea), occurs constantly in all Tricyrtida and Stichocyrtida. It is a simple large chamber in the Tricyrtida, but forms an annulated body, composed of a variable number of successive joints, in the Stichocyrtida. The constrictions between these joints, and also the lumbar constriction, between abdomen and thorax, are usually provided with a lattice-girdle, projecting into the cavity of the shell, like a diaphragm. Usually this horizontal girdle bears only a single circle of pores, rarely two or more. In many Cyrtoidea it is replaced by a solid horizontal ring of silex, and often it is wanting. It originates by the insertion of the following shell-joint, which takes place not on the terminal mouth of the preceding joint, but somewhat above it.

The annular joints of the Stichocyrtida succeeding the third joint, and very variable in number, may be regarded either as a series of new postabdominal chambers, succeeding the true abdomen, or as secondary joints of the annulated abdomen itself. The latter view may be sustained by the fact that these joints are usually of an indifferent shape, and do not possess the characteristic features which we find in the first three joints, the abdomen, the thorax and the cephalis.

The lattice-work of the shell exhibits in the Cyrtoidea an extraordinary variety, similar to that of the Sphæroidea; it serves in the first place for the distinction of species. The three first joints of the shell are often distinguished by the different character of the lattice-work. The cephalis has usually very small and simple pores. The lattice-work of the thorax is often characterised by radial structures. The pores of the abdomen are usually very numerous and regular. The numerous joints in the annulated abdomen of the Stichocyrtida commonly exhibit little variety.

The closure of the mouth, effected by a convex or horizontal terminal lattice-plate, has a different signification in the Monocyrtida and in the jointed Cyrtoidea. In the Monocyrtida clausa this closing plate is the original cortinar plate or the basal plate of the cephalis. In the jointed Cyrtoidea, however, the lattice-plate which closes the terminal mouth of the thorax or of the abdomen (of the last annular joint in the Stichocyrtida), is produced by central union of the convergent edges, which grow centripetally from the margin of the mouth of the last joint towards its centre.

The radial apophyses arising from the shell of the Cyrtoidea may probably be always derived from that tripodal structure which is found in all Plectoidea, in *Cortina* and *Cortiniscus* among the Stephoidea, and in the majority of Spyroidea. Therefore the prototype of this radial structure would be *Plagoniscus* and *Cortina*, with four radial spines united in a common point, the cortinar centrum; an ascending apical horn and three descending basal feet. The odd posterior or caudal foot is usually similar in shape to the two paired anterior or pectoral feet, but may be distinguished from these latter by its relation to the apical horn. Very frequently an internal vertical free columella arises in the cephalis, or instead of it an ascending rib in the dorsal wall of the cephalis, which connects the base of the apical horn with the origin of the caudal foot. This is probably the remaining part of the sagittal ring. More rarely also a part of the ventral rod of the latter is preserved, or on the anterior pole of the basal rod of the cephalis an ascending procolumella arises which is inserted on the frontal face of the cephalis, and sometimes prolonged into a nasal horn (the rod, C, of Bütschli). These two odd horns, the posterior apical horn and the anterior nasal horn, are usually different and divergent. In some genera a variable number of accessory radial horns is developed on the convex face of the cephalis. In many hornless genera the free apical horn is lost, but not unfrequently the columella is preserved which connects the caudal foot with that point of the cephalis, in which formerly the apical horn was inserted.

The three primary radial beams, corresponding to the three basal feet of *Plectaniscus* and *Cortina*, exhibit in the Cyrtoidea the greatest variety in form and size, and chiefly in their relation to the shell, the latter serving mainly for the distinction of genera. Originally these three cortinar beams arise from the basal plate of the cephalis, the odd caudal foot appearing as a prolongation of the basal rod of that plate, and the paired pectoral feet as prolongations of its coracal rods (between the jugular and cardinal pores). The lattice-work of the thorax is developed usually between the three cortinar feet, more rarely inside or outside of them. Therefore the three beams appear commonly as three divergent ribs in the wall of the thorax, and continue over its basal mouth as three free terminal feet. With the increasing length of the shell and the number of its joints the three radial ribs are also prolonged, and their free distal ends may be prominent at very different points, either as three lateral wings or as three terminal feet. These are either solid spines or lattice-plates, sometimes more or less ramified.

The three radial apophyses are prevalent in the majority of the Cyrtoidea, which we call "Pilocyrtida" (or Cyrtoidea triradiata). Their number increases in the Astrocyrtida (or Cyrtoidea multiradiata). The most frequent cases of multiplication are here caused by the development of six or nine radial apophyses; these may be enclosed ribs, or lateral wings, or terminal feet. In the sexradial Cyrtoidea there are three secondary or interradial apophyses interpolated between the three primary or perradial; in the nine-radial Cyrtoidea, however, there are six adradial apophyses interpolated.

A third and last great group is formed by the Corocyrtida or Cyrtoidea eradiata. These exhibit no radial apophyses, neither enclosed ribs, nor free lateral wings, nor terminal feet. But in a great number of them internal traces of an original triradiate structure are visible, mainly in the cortinar septum between cephalis and thorax; this often exhibits three or four, and sometimes six cortinar or collar pores, of the same typical shape as in the triradial Spyroidea. Sometimes even an internal columella with three radial branches is preserved, as in *Axocorys*. It is therefore very probable that a great part of these Cyrtoidea eradiata (if not all) may be derived from triradiate or multiradiate ancestral forms, by reduction and loss of the radial apophyses. In another part of this group, mainly in the Monocyrtida eradiata (Cyrtocalpida) it is possible, or even probable, that their eradiate shell has originated independently from Nassellida, and that they have no true relation to radial Cyrtoidea.

*The Central Capsule* of the Cyrtoidea, first observed by J. Müller (1858), and more fully described in my Monograph (1862), was very accurately examined by Richard Hertwig (1879). His observations were confirmed by numerous new forms, which I was able to examine in well-preserved preparations of the Challenger. The central capsule, according to these, exhibits the same typical shape, which is characteristic of all MONOPYLEA (with porochora and podoconus), and may be derived with the latter from the common ancestral forms, *Cystidium* and *Nassella* (=the skeletonless Nassellida). In

the majority, however, of Cyrtoidea, the capsule develops on its basal face a number of depending lobes, as were also found in some Spyroidea (and probably also Botryodea). In this respect we may distinguish two main forms of the capsule in the Cyrtellaria, viz., the primary simple, not lobate form, and the secondary lobate form. The central capsule is originally always enclosed in the cephalis, and has there a simple, subspherical, ellipsoidal or ovate form. As soon as their growth increases, and the enclosing cephalis becomes too narrow, it sends out prolongations in the form of basal lobes, which depend from its base, and proceed through the pores of the basal lattice of the cephalis, or the cortinar pores. In the great majority of Cyrtoidea in which the capsule was observed, either three or four such lobes were seen (already described by J. Müller). Of course this number depends upon the number of cortinar pores, which is either three or four; therefore in the Cyrtoidea with three pores in the cortinar plate, we find three lobes of the central capsule (an odd posterior and two paired anterior); in the Cyrtoidea, however, with four pores in the cortinar plate (the majority) we find four lobes of the central capsule (two smaller anterior jugular and two larger posterior cardinal lobes). Usually each lobe is ovate or pear-shaped and encloses a large oil-globule, and often also an apophysis of the cell-nucleus.

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## Section I. MONOCYRTIDA, Haeckel, 1862, Monogr. d. Radiol, pp. 280, 281.

*Definition.*—Cyrtoidea monothalamia, with simple, not jointed shell (or cephalis), without transverse constrictions.

*Synopsis of the three Families and six Subfamilies of Monocyrtida.*

| | | |
|---|---|---|
| Family LIX. Tripocalpida. Three radial apophyses. | Mouth open, | 1. Archipilida. |
| | Mouth closed, | 2. Archiperida. |
| Family LX. Phænocalpida. Numerous radial apophyses. | Mouth open, | 3. Archiphormida. |
| | Mouth closed, | 4. Archiphænida. |
| Family LXI. Cyrtocalpida. No radial apophyses. | Mouth open, | 5. Archicorida. |
| | Mouth closed, | 6. Archicapsida. |

### Family LIX. TRIPOCALPIDA, n. fam.

*Archipilida et Archiperida*, Haeckel, 1881, Prodromus, pp. 427, 429.

*Definition.*—Monocyrtida triradiata. (Cyrtoidea with a simple, not jointed shell, representing a simple cephalis, with three radial apophyses.)

The family Tripocalpida, composed of the Archipilida and Archiperida of my Prodromus, comprises those Cyrtoidea in which the lattice-shell is quite simple, without transverse constriction, and bears three radial apophyses. The two subfamilies differ in the shape of the basal mouth, which in the Archipilida is a simple wide opening, in the Archiperida closed by a lattice-plate; the former are here divided into eight, the latter into seven different genera.

Only three species of this family were hitherto described, all three belonging to the Archipilida, viz., (1) *Tripocalpis galea* (fossil in Barbados, figured by Ehrenberg, 1875, as *Halicalyptra galea*), (2) *Tripodiscium campanula* (fossil in Sicily, figured by Stöhr, 1880, as *Carpocanium*); and (3) *Tridictyopus elegans*, of which Richard Hertwig gave an excellent description in 1879, with an accurate figure of the central capsule. All the other species of the family (seventy) are new.

The shell in the majority of Tripocalpida is ovate or campanulate, sometimes conical or three-sided pyramidal. Three radial apophyses are constantly distinct, either three lateral wings or three terminal feet; these are usually solid spines, rarely lattice-plates. The top of the shell usually bears an apical horn, rarely two or more horns; often the horn is wanting. The lattice-work of the shell is very various in the different species, and often of a remarkable structure (Pl. 51, figs. 6–8; Pl. 98, figs. 4–8). The cavity of the shell is in all Archipilida, and in a part of the Archiperida (*Peridium, Archipera, Archibursa*) quite simple. In the other part of the Archiperida, however, constituting the peculiar group of Euscenida (genera 504–507), a vertical columella arises in the centre of the basal plate, and is prolonged upwards in the apical horn; this columella is either simple (*Euscenium, Archiscenium*) or branched (*Cladoscenium, Pteroscenium*); in the latter case the ascending branches are disposed in triradiate verticils and are inserted on the inner face of the shell (compare Pl. 53, figs. 11–16, and Pl. 98, figs. 1–4).

The phylogenetic origin of the Tripocalpida may be very divergent, and their morphological affinity to the other NASSELLARIA is a very complicated problem. The Euscenida (genera 504–507) may be derived directly from the Plagonida (*Plagoniscus*) or Plectanida (*Plectaniscus*). The Archibursida (genera 508–510) however, manifest a closer affinity to the Tripospyrida, and may be derived from them by reduction of the sagittal ring and constriction. In these two groups of Archiperida the shell may be regarded as a true cephalis. In the Archipilida, however, where the shell has a wide basal opening and the three radial ribs arise originally from the base of the apical horn, the shell itself may correspond to the thorax of the Dicyrtida, and may be derived from these by loss of the cephalis. This is the more probable, as sometimes a small remnant of the reduced cephalis is preserved (Pl. 98, fig. 8). None of these difficult questions can be answered until a much closer morphological knowledge of the Tripocalpida is acquired.

*Synopsis of the Genera of Tripocalpida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Archipilida. Basal mouth of the shell a simple wide opening. | Shell with three lateral ribs or wings, with or without terminal feet. | Three terminal feet. | Apex with a horn, | 496. *Tripocalpis.* |
| | | | No apical horn, | 497. *Tripodonium.* |
| | | Six to nine or more terminal feet. | No apical horn, | 498. *Tripterocalpis.* |
| | | No terminal feet. | Apex with a horn, | 499. *Trissopilium.* |
| | | | No apical horn, | 500. *Archipilium.* |
| | Shell without lateral ribs or wings but with three terminal feet. | Feet simple or branched, not latticed. | Apex with a horn, | 501. *Tripilidium.* |
| | | | No apical horn, | 502. *Tripodiscium.* |
| | | Feet latticed. | Apex with a horn, | 503. *Tridictyopus.* |
| II. Subfamily Archiperida. Basal mouth of the shell closed by a lattice-plate. | Shell in its axis with a free (simple or branched) internal columella, prolonged into an apical horn. | Shell with three free feet, without lateral lattice-wings. | Columella simple, | 504. *Euscenium.* |
| | | | Columella branched, | 505. *Cladoscenium.* |
| | | Shell with three lateral lattice-wings, connecting the three feet with the horn. | Columella simple, | 506. *Archiscenium.* |
| | | | Columella branched, | 507. *Pteroscenium.* |
| | Shell with simple cavity, without free columella. Three free basal feet. | | One apical horn, | 508. *Peridium.* |
| | | | Two or more horns, | 509. *Archipera.* |
| | | | No apical horn, | 510. *Archibursa.* |

Subfamily 1. ARCHIPILIDA, Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Tripocalpida with the basal mouth of the shell open (vel Monocyrtida triradiata aperta).

Genus 496. *Tripocalpis*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archipilida (vel Monocyrtida triradiata aperta) with three lateral ribs prolonged into three terminal feet. Apex with a horn.

The genus *Tripocalpis* opens the series of Archipilida, or of those Monocyrtida in which the monothalamous shell exhibits a distinct triradial structure, and a simple open mouth, without cortinar lattice. *Tripocalpis* is probably the most primordial of the Archipilida, and has three lateral ribs, which are prolonged into three free terminal

[1] *Tripocalpis* = Urn with three feet; τρίπους, κάλπις.

feet, and connected in the apex of the pyramidal or campanulate shell with the apical horn. It may probably be derived from *Dictyophimus* by loss of the cephalis. The central capsule is simple, spherical, or ellipsoidal.

1. *Tripocalpis plectaniscus*, n. sp.

Shell three-sided pyramidal, smooth, about as long as broad, with irregular polygonal pores and thin bars. Apical horn stout, three-sided pyramidal, about as long as the shell. From the three edges of its base arise three prominent straight radial ribs, which are prolonged into three large divergent feet, of equal size and the same form as the horn.

*Dimensions.*—Shell 0·1 diameter, horn and feet 0·12.

*Habitat.*—Tropical Pacific (Philippine Sea), Station 206, depth 2100 fathoms.

2. *Tripocalpis galea*, Haeckel.

*Halicalyptra galea*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 74, Taf. ii. fig. 10.

Shell campanulate, rough, about as long as broad, with irregular roundish pores and thick bars. Apical horn stout, three-sided pyramidal, scarcely one-fourth as long as the shell. Beyond its base there arise three prominent, slightly curved lateral ribs, which are prolonged into three pyramidal, slightly divergent stout feet, somewhat shorter than the shell.

*Dimensions.*—Shell 0·08 to 0·09 diameter, horn 0·02, feet 0·07.

*Habitat.*—Fossil in Barbados.

3. *Tripocalpis tricostata*, n. sp.

Shell ovate campanulate, one and a half times as long as broad, with regular circular pores, disposed in alternate longitudinal rows. Apical horn three-sided pyramidal, stout, half as long as the shell. In the middle of the shell there arise three wing-like lateral ribs, which are prolonged into three broad, slightly curved, divergent terminal feet.

*Dimensions.*—Shell 0·12 long, 0·08 broad, horn and feet 0·06 to 0·08.

*Habitat.*—Fossil in Barbados.

4. *Tripocalpis triserrata*, n. sp. (Pl. 51, fig. 6).

Shell ovate, nearly twice as long as broad. The three sides of the shell, between the three large ribs, are provided each with nine delicate parallel, longitudinal, slightly curved ribs, alternating with ten longitudinal rows of regular circular pores about as broad as the bars. Apical horn short and broad, three-sided pyramidal; from the three edges of its base there arise three wing-like serrate main ribs, which are prolonged into three short pyramidal terminal feet.

*Dimensions.*—Shell 0·12 long, 0·07 broad, horn and feet 0·01.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

5. *Tripocalpis cortinaris*, n. sp. (Pl. 97, fig. 3).

Shell hemispherical, one and a half times as broad as long, with regular, circular, hexagonally framed pores. Apical horn stout, three-sided pyramidal, with three serrate edges. From the base of the latter arise three strongly dentate and curved lateral ribs, with recurved teeth, and these are prolonged into the serrate convex edge of the three basal feet, which are crescentic and twice as long as the shell.

*Dimensions.*—Shell 0·07 long, 0·1 broad; horn 0·06 long, feet 0·14 long.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

Genus 497. *Tripodonium*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archipilida (vel Monocyrtida triradiata aperta) with three lateral ribs prolonged into three terminal feet. Apex without horn.

The genus *Tripodonium* differs from the preceding *Tripocalpis*, its probable ancestral form, only in the loss of the apical horn (already very small in some forms of the latter). It bears therefore to the latter the same relation that *Sethopilium* does to *Dictyophimus*.

1. *Tripodonium campanulatum*, n. sp.

Shell campanulate, somewhat broader than high, with regular circular pores, twice as broad as the bars. Three broad lateral wings, lamellar, triangular, are prolonged over the peristome into three short triangular lamellar feet, one-fourth as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·09 broad; feet 0·02 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Tripodonium ovatum*, n. sp.

Shell ovate, one and one-third times as long as broad, with numerous and small circular pores, scarcely as broad as the bars. Three prominent longitudinal ribs, arising in the lower half of the shell-wall, are prolonged into three divergent conical curved feet, about half as long as the shell.

*Dimensions.*—Shell 0·12 long, 0·09 broad; feet 0·06 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

Genus 498. *Tripterocalpis*,[2] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archipilida (vel Monocyrtida triradiata aperta) with three lateral wings and a peristomial corona of numerous terminal feet. Shell ovate, with constricted mouth, without apical horn.

[1] *Tripodonium* = Shell with three feet.

[2] *Tripterocalpis* = Urn with three wings; τρίπτερος, καλπίς.

The genus *Tripterocalpis* is distinguished from the other Archipilida by the remarkable combination of three lateral wings and of numerous (six to nine or more) terminal feet. It may be derived directly from the preceding *Tripodocalpis* by multiplication of the terminal feet. These are sometimes obliquely directed. The central capsule is ellipsoidal or ovate, and fills up the greater part of the shell.

1. *Tripterocalpis phylloptera*, n. sp. (Pl. 51, fig. 1).

Shell slender, ovate, nearly twice as long as broad. Pores circular, of different sizes and at unequal distances. Along the lower half of the shell there arise three broad triangular lamellar wings. Peristome with twelve conical, nearly parallel and vertical feet, about one-sixth as long as the shell.

*Dimensions.*—Shell 0·2 long. 0·12 broad; wings 0·1 long, feet 0·03 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Tripterocalpis conoptera*, n. sp. (Pl. 51, fig. 2).

Shell ovate, nearly as broad as long. Pores regular, circular, quincuncial, twice as broad as the bars. In the middle of the shell there arise three conical, smooth, divergent wings, about half as long as the shell. Peristome with six short triangular, oblique, convergent feet.

*Dimensions.*—Shell 0·16 long, 0·14 broad; wings 0·09 long; feet 0·02 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Tripterocalpis ogmoptera*, n. sp. (Pl. 51, figs. 3–5).

Shell ovate, nearly as broad as long. Pores small and numerous, circular or roundish, partly confluent, double-contoured (fig. 4). In the middle of the shell there arise three very large conical divergent wings, which are longitudinally striped and longer than half the shell. Peristome with nine short triangular, oblique, convergent feet.

*Dimensions.*—Shell 0·18 long, 0·16 broad; wings 0·12 long, feet 0·02 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 499. *Trissopilium*,[1] Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Archipilida (vel Monocyrtida triradiata aperta) with three lateral ribs or wings. Mouth smooth, without terminal feet. Apex with a horn.

The genus *Trissopilium* and the following nearly allied *Archipilium* differ from the other Archipilida in the absence of terminal feet, the peristome being quite simple, and truncate. But there are three lateral wings, arising either from the apex or from the lateral sides of the monothalamous shell. *Trissopilium* may perhaps be derived from *Lithomelissa* by reduction of the cephalis.

[1] *Trissopilium* = Small hat with three wings; τρίσσος, πίλιον.

1. *Trissopilium tetraplecta*, n. sp.

Shell in the upper half three-sided pyramidal, in the lower half inversely hemispherical, of equal length and breadth. Pores irregular, roundish, in the upper half larger. From the apex there diverge four equal, straight and stout, three-sided pyramidal spines, one of which is vertically ascending (the horn), the three others obliquely descending (the wings). The distal half of the latter is free, whilst the proximal half forms three ribs, enclosed in the shell-wall. Mouth constricted, half as broad as the shell.

*Dimensions.*—Shell 0·08 long and broad, horn and wings 0·1 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

2. *Trissopilium lithomelissa*, n. sp.

Shell ovate, one and one-third times as long as broad. Pores circular, of different sizes, small and numerous. Apical horn very large, straight, cylindrical, vertical, longer than the shell. Three lateral wings shorter, arising from the middle of the shell, conical, curved, divergent. Mouth truncate, two-thirds as broad as the shell.

*Dimensions.*—Shell 0·11 long, 0·08 broad; horn 0·13 long, wings 0·09 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 500. *Archipilium*,[1] Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Archipilida (vel Monocyrtida triradiata aperta) with three lateral ribs or wings. Mouth truncate, without terminal feet. Apex without horn.

The genus *Archipilium* differs from the nearly allied *Trissopilium*, its probable ancestral form, in the absence of the apical horn. The three lateral wings of the ovate shell are stout spines. It may also be derived from the similar *Sethopilium* by reduction and loss of the cephalis.

1. *Archipilium orthopterum*, n. sp. (Pl. 98, fig. 7).

Shell ovate, smooth, nearly cylindrical, scarcely broader than the truncate, widely open mouth. Pores numerous, irregular, roundish, of very different sizes. Three lateral wings arising from the middle zone, twice as long as the shell, straight, divergent, stout, cylindrical, longitudinally striped.

*Dimensions.*—Shell 0·08 long, 0·06 broad; wings 0·15 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Archipilium sigmopterum*, n. sp.

Shell ovate, smooth, nearly campanulate, of equal length and breadth, one and one-third times as broad as the truncate, slightly constricted mouth. Pores scarce, irregularly formed and

[1] *Archipilium* = Primordial hat; ἀρχιπίλιον.

scattered, of very different sizes. Three lateral wings, stout, prismatic, about as long as the shell widely divergent and S-shaped, curved.

*Dimensions.*—Shell 0·08 diameter, wings 0·08 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Archipilium cyrtopterum*, n. sp.

Shell ovate, rough, twice as broad as the constricted mouth. Pores small and numerous, subregular, circular, smaller than the bars. Three lateral wings cylindrical, crescentic, in the upper half divergent, in the lower convergent, one and one-half times as long as the shell.

*Dimensions.*—Shell 0·09 long, 0·07 broad; wings 0·14 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

## Genus 501. *Tripilidium*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archipilida (vel Monocyrtida triradiata aperta) without lateral ribs, with three simple or branched terminal feet and an apical horn.

The genus *Tripilidium* differs from *Tripodonium* in the absence of the three lateral ribs, and may be derived either from this ancestral form, or directly from *Tripospyris* (by loss of the sagittal ring and constriction); perhaps also from *Lychnocanium* (by reduction of the cephalis). We distinguish as two subgenera *Tristylocorys* (with simple feet) and *Tripodocorys* (with branched feet).

### Subgenus 1. *Tristylocorys*, Haeckel.

*Definition.*—Feet simple, not branched.

1. *Tripilidium cortina*, n. sp.

Shell campanulate, rough, about as long as broad. Pores subregular, circular, larger in the middle zone, twice to three times as broad as the bars. Mouth constricted, half as broad as the shell. Apical horn straight and stout, three-sided pyramidal, about as long as the shell. Three feet divergent, slightly S-shaped, curved, somewhat longer than the shell.

*Dimensions.*—Shell 0·1 diameter, horn 0·09 long, feet 0·13 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Tripilidium hemisphæricum*, n. sp.

Shell hemispherical, smooth, nearly twice as broad as long. Pores large, with thin bars, irregular, roundish, of very different sizes. Mouth wide open. Apical horn conical, half as long as

[1] *Tripilidium* = Small hat with three feet; τρια, πιλιδιον.

the shell. Three feet slender cylindrical, widely divergent, curved, nearly twice as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·14 broad; horn 0·05 long, feet 0·15 long.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

3. *Tripilidium lychnocanium*, n. sp.

Shell hemispherical, thorny, one and a half times as broad as long. Pores regular, circular, hexagonally framed, as broad as the bars. Mouth slightly constricted. Apical horn stout and short, three-sided pyramidal. Three feet cylindrical, straight, divergent, twice to three times as long as the shell. (Similar to *Lychnocanium favosum*, Pl. **61**, fig. 6, perhaps derived from it by reduction of the cephalis.)

*Dimensions.*—Shell 0·08 long, 0·12 broad; horn 0·02 long, feet 0·2 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

4. *Tripilidium ovatum*, n. sp.

Shell ovate, smooth, one and a half times as long as broad. Pores regular, circular, as broad as the bars. Mouth constricted, half as broad as the shell. Horn short, conical. Three feet conical, curved, convergent, scarcely one-third as long as the shell.

*Dimensions.*—Shell 0·15 long, 0·11 broad; horn 0·02 long, feet 0·04 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

5. *Tripilidium clavatum*, n. sp.

Shell nearly spherical, tuberculate, a little broader than long. Pores regular, circular, as broad as the bars. Mouth constricted, half as broad as the shell. Apical feet and the three divergent feet of equal size and similar form, about as long as the shell, straight, in the basal half smooth, cylindrical, in the distal half club-shaped, dimpled. (Very similar to *Triospyris conifera* and *Triospyris eucolpos*, Pl. **84**, figs. 7 and 4; but the spherical shell exhibits no trace of sagittal ring or constriction, and the simple shell-cavity has a wide open mouth, and is not closed by a basal plate.)

*Dimensions.*—Shell 0·1 diameter, horn and feet 0·08 to 0·09 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

6. *Tripilidium costatum*, n. sp. (Pl. **98**, figs. 8, 8*a*, 8*b*).

Shell ovate, spinulate and costate, nearly twice as broad as long. Surface with fifteen to twenty prominent longitudinal ribs, which are convergent towards each pole and elegantly denticulate. The deep furrows between them are divided by delicate, parallel, transverse ribs into numerous short and broad dimples (thirty to forty in each furrow); each dimple contains a small pore, like a transverse

fissure. The apex bears a short and stout, three-sided pyramidal horn, the hollow base of which is closed by a small cortinar septum with three collar pores (fig. 8*b*). This seems to indicate a rudimentary cephalis and the derivation of this species from *Lychnocanium* (Pl. **61**). Peristome constricted, only one-fourth as broad as the shell, with three short, conical, nearly vertical feet. The central capsule (fig. 8*a*) in the specimen examined was well preserved, hemispherical, not lobate, and filled up the upper half of the shell-cavity (beyond the rudiment of the cortinar septum).

*Dimensions.*—Shell 0·2 long, 0·12 broad; horn 0·01 long, feet 0·02 long.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

### 7. *Tripilidium elongatum*, n. sp.

Shell elongate, smooth, nearly cylindrical, in the upper third conical. Pores small and numerous, regular, circular, half as broad as the bars, disposed in about thirty longitudinal alternating rows. Peristome scarcely constricted. The apical horn and the three parallel feet are of equal size and similar form, straight, conical, one-sixth as long as the shell.

*Dimensions.*—Shell 0·12 long, 0·06 broad; horn and feet 0·02 long.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Tripodocorys*, Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Feet forked or branched.

### 8. *Tripilidium dichopodium*, n. sp.

Shell hemispherical, nearly twice as broad as long, smooth. Pores irregular, roundish, twice to four times as broad as the bars. Mouth wide open. Apical horn spindle-shaped, half as long as the shell. Three feet cylindrical, nearly straight and parallel, as long as the shell, forked at the distal end. (Exhibits an external similarity to *Tripospyris semantis*, Pl. **84**, fig. 2, but has no trace of sagittal ring and constriction, and the simple shell-cavity has a wide open mouth.)

*Dimensions.*—0·06 long, 0·1 broad; horn 0·03 long, feet 0·07 long.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

### 9. *Tripilidium cladopodium*, n. sp.

Shell campanulate, rough, about as long as broad. Pores subregular, circular, as broad as the bars. Mouth slightly constricted. Apical horn and three divergent feet of nearly equal size and form, three-sided prismatic, straight and stout, irregularly dentate and branched, somewhat longer than the shell.

*Dimensions.*—Shell 0·08 diameter; horn and feet 0·1 to 0·12 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

Genus 502. *Tripodiscium*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archipilida (vel Monocyrtida triradiata aperta) without lateral ribs and apical horn, with three simple or branched terminal feet.

The genus *Tripodiscium* may be derived either from the preceding *Tripilidium* by loss of the apical horn, or from the nearly related *Tristylospyris* by loss of the sagittal ring and constriction. Some forms of the latter genus can scarcely be distinguished from similar species of the former.

Subgenus 1. *Tripodiscinus*, Haeckel.

*Definition.*—Feet simple, not branched nor forked.

1. *Tripodiscium tristylospyris*, n. sp.

Shell subspherical, with regular, circular pores, twice as broad as the bars. Mouth constricted, half as broad as the shell, with three short spindle-shaped feet, which are nearly parallel and vertical, half as long as the shell. (Similar to *Tristylospyris scaphipes*, Pl. 84, fig. 13, but without sagittal ring and constriction.)

*Dimensions.*—Shell 0·08 long, 0·07 broad; feet 0·04 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Tripodiscium ovatum*, n. sp.

Shell ovate, rough, nearly as broad as long. Pores regular circular, double-contoured, twice as broad as the bars. Mouth constricted, one-third as broad as the shell, with three convergent short triangular feet.

*Dimensions.*—Shell 0·1 long, 0·09 broad; feet 0·02 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Tripodiscium clavatum*, n. sp.

Shell ovate, smooth, one and a half times as long as broad. Pores irregular roundish, of different sizes. Mouth constricted, two-thirds as broad as the shell, with three divergent, straight club-shaped feet, nearly as long as the shell.

*Dimensions.*—Shell 0·12 long, 0·08 broad; feet 0·1 long.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

[1] *Tripodiscium* = Shell with three small feet; τρία, ποδίσκιον.

4. *Tripodiscium campanula*, Haeckel.

*Carpocanium campanula*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 96, Taf. iii. fig. 9.

Shell campanulate or subspherical, smooth, about as long as broad. Pores small, regular circular, as broad as the bars. Mouth constricted, about half as broad as the shell, with three short conical descending feet.

*Dimensions.*—Shell 0·06 long, 0·05 broad; feet 0·02 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms; fossil in Sicily.

## Subgenus 2. *Tripodisculus*, Haeckel.

*Definition.*—Feet branched or forked.

5. *Tripodiscium furcatum*, n. sp.

Shell ovate, rough, nearly as broad as long. Pores subregular, circular, twice as broad as the bars. Mouth constricted, two-thirds as broad as the shell, with three divergent parallel and vertical feet, which are as long as the shell, and forked at the distal end.

*Dimensions.*—Shell 0·09 long, 0·08 broad; feet 0·07 long.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

6. *Tripodiscium ramosum*, n. sp.

Shell ovate, tuberculate, nearly as broad as long. Pores irregular, roundish, of very different sizes. Mouth constricted, half as broad as the shell, with three large, divergent, irregularly branched feet, nearly twice as long as the shell. (Similar to *Tristylospyris ramosa*, Pl. 52, fig. 23, but without sagittal ring and constriction.)

*Dimensions.*—Shell 0·07 long, 0·06 broad; feet 0·15 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

7. *Tripodiscium sphærocephalum*, n. sp. (Pl. 52, fig. 21).

Shell subspherical, rough, with circular pores of different sizes. Mouth constricted, circular, simple, two-thirds as broad as the shell, with three large divergent feet, which are three-sided prismatic, irregularly branched, and twice as long as the shell.

*Dimensions.*—Shell 0·07 long, 0·08 broad; feet 0·12 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 503. *Tridictyopus*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Arehipilida (vel Monocyrtida triradiata aperta) with three latticed terminal feet. Shell ovate or subconical, with an apical horn.

The genus *Tridictyopus* differs from the nearly allied *Tripilidium* in the possession of three large fenestrated shovel-shaped feet, forming direct prolongations of the large conical shell. The lattice work exhibits a peculiar elegant structure recurring in the similar, perhaps nearly related, *Cephalospyris* (Pl. 83, fig. 10; Pl. 96, fig. 28). The central capsule is large, ellipsoidal or ovate, and fills up the greater part of the shell cavity (compare R. Hertwig, 1879, *loc. cit.*, p. 75).

1. *Tridictyopus vatillum*, n. sp. (Pl. 51, fig. 8).

Shell campanulate, about as long as broad (excluding horn and feet). Pores irregular, polygonal, in the middle part more regular, triangular. Horn short and stout, three-sided pyramidal. Three feet large, triangular, shovel-shaped, about half as long as the shell.

*Dimensions.*—Shell 0·14 long, 0·15 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

2. *Tridictyopus conulus*, n. sp. (Pl. 51, fig. 7).

Shell campanulate conical, about one and a half times as long as broad (excluding horn and feet). Pores mostly triangular, disposed in subregular hexagonal figures, which are separated by bands of smaller irregular polygonal pores. Horn short and stout, three-sided pyramidal. Three feet triangular shovel-shaped, convergent, about one-sixth as long as the shell.

*Dimensions.*—Shell 0·3 long, 0·2 broad; horn 0·04 long, feet 0·05 long.

*Habitat.*—Equatorial Atlantic, Station 347, depth 2250 fathoms.

3. *Tridictyopus elegans*, R. Hertwig.

*Tridictyopus elegans*, R. Hertwig, 1879, Organismus d. Radiol., p. 75, Taf. vii. fig. 3, 3*a*, 3*b*.

Shell slender, conical, campanulate, about twice as long as broad (excluding horn and feet). Most pores subregular triangular, with some irregular polygonal ones intermingled. The horn in the two observed specimens was broken off, together with the conical apex of the shell. Three feet triangular shovel-shaped, about one-sixth as long as the shell.

*Dimensions.*—Shell 0·3 long, 0·15 broad; feet 0·05 long.

*Habitat.*—Mediterranean (Messina), R. Hertwig, surface.

[1] *Tridictyopus* = Shell with three lattice-feet; τρία, δίκτυον, πούς.

Subfamily 2. ARCHIPERIDA, Haeckel, 1881, p. 429.

*Definition.*—Tripocalpida with the basal mouth of the shell fenestrated (vel Monocyrtida triradiata clausa).

Genus 504. *Euscenium*,[1] n. gen.

*Definition.*—Archiperida (vel Monocyrtida triradiata clausa) with a free simple internal columella, prolonged into an apical horn. Three basal feet free, without lateral wings.

The genus *Euscenium* and the three following nearly allied genera form together the remarkable small group of Euscenida, probably one of the oldest and most primitive of all Cyrtoidea, and perhaps the common root of this suborder, arising directly from the Plectoidea. The simple skeleton is composed of four radial beams united in one point (the cortinar centrum). Three beams are directed downwards, and form three divergent basal feet; the fourth beam is directed upwards and represents an apical horn; its basal part is enclosed as "columella" in the cavity of the simple shell, the lattice-work of which connects the four spines (compare above, *Plectaniscus*, p. 924). In the genus *Euscenium*, the simplest of all, the columella is simple, and the three feet also simple, without wings.

Subgenus 1. *Euscenarium*, Haeckel.

*Definition.*—Three feet simple, not branched.

1. *Euscenium plectaniscus* (Pl. 98, fig. 1).

Shell three-sided pyramidal, thorny, about as long as broad, with three dentate edges. Framework very loose, with irregular polygonal meshes; in the middle of each of the three triangular sides a horizontal band of denser network. Basal plate with three very large simple collar-holes. The apical horn and the three feet are three-sided pyramidal, about half as long as the columella, with three prominent irregularly dentate edges. The horn is straight, whilst the three feet are hook-shaped, its distal end being curved downwards and inwards.

*Dimensions.*—Shell 0·11 long, 0·13 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

2. *Euscenium archicyrtis*, n. sp.

Shell three-sided pyramidal, smooth, nearly as long as broad, with three straight edges connected by irregular loose framework with polygonal meshes. Basal plate with three very large

[1] *Euscenium*=Nice small tent; εὖ σκηνίον.

simple collar-holes. The apical horn and the three feet are three-sided prismatic, smooth, about twice as long as the columella, straight and widely divergent.

*Dimensions.*—Shell 0·08 long, 0·1 broad.

*Habitat.*—Tropical Pacific, Station 225, depth 4475 fathoms.

### 3. *Euscenium hemisphæricum*, n. sp.

Shell hemispherical smooth, half as long as broad, with small and numerous subregular circular pores. Basal plate with three large triangular simple collar-holes. Horn slender, three-sided prismatic, twice as long as the columella. Feet very slender, with three denticulate edges, widely divergent and curved like the quadrant of a circle.

*Dimensions.*—Shell 0·04 long, 0·06 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 4. *Euscenium tricolpium*, n. sp. (Pl. 53, fig. 12).

*Archiscenium tricolpium*, Haeckel, 1881, Prodromus et Atlas, *loc. cit.*

Shell cap-shaped, nearly hemispherical, with three vaulted hemispherical bosoms between the three arches ascending from the feet to the horn. Network very irregular, with polygonal meshes, of different form and size. Basal plate with three large primary and some smaller irregular accessory collar-holes. Horn slender, straight, twice as long as the columella. Feet of the same length, slender, widely divergent, slightly curved. The three edges of the horn and the feet are elegantly denticulated.

*Dimensions.*—Shell 0·04 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### 5. *Euscenium tripospyris*, n. sp. (Pl. 84, fig. 8).

*Tripospyris euscenium*, Haeckel, 1881, Prodromus et Atlas.

Shell nearly spherical, smooth, with numerous small circular pores. Basal plate also with numerous small pores. Horn and feet stout, three-sided prismatic, straight or slightly curved, about as long as the thin, somewhat curved columella. This species is closely allied to *Tripospyris*.

*Dimensions.*—Shell 0·11 to 0·12 diameter, horn and feet 0·08 to 0·1 long.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

## Subgenus 2. *Euscenidium*, Haeckel.

*Definition*—Feet forked or branched.

### 6. *Euscenium furcatum*, n. sp.

Shell campanulate, smooth, with numerous irregular roundish pores. Basal plate with nine pores (three larger central and six smaller distal). Horn club-shaped, half as long as the columella.

Feet twice as long, cylindrical, parallel, vertical, forked at the distal end. (Similar to *Tripospyris semantis*, Pl. **84**, fig. 2, but without sagittal feet.)

*Dimensions.*—Shell 0·07 long, 0·06 broad; horn 0·04 long, feet 0·1 long.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

### 7. *Euscenium quadratum*, n. sp.

Shell campanulate, smooth, with subregular square pores. Basal plate with three large pores. Horn and feet of the same size and shape, twice as long as the columella, three-sided prismatic, each with four or five verticils of lateral branches. (Similar to the cephalis of *Clathrocorys murrayi*, Pl. **64**, fig. 8, but with four free spines without connecting lattice-wings.)

*Dimensions.*—Shell 0·06 long, 0·05 broad; horn and feet 0·12 long.

*Habitat.*—Central Pacific, Station 272, surface.

### 8. *Euscenium ramosum*, n. sp.

Shell subspherical, rough, with small subregular circular pores. Basal plate with nine pores (three larger central and six smaller distal pores). Horn and feet of the same size and form, three to four times as long as the columella, three-sided prismatic, irregularly branched.

*Dimensions.*—Shell 0·06 diameter, horn and feet 0·15 to 0·2 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 505. *Cladoscenium*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archiperida (vel Monocyrtida triradiata clausa) with a free branched internal columella, prolonged into an apical horn. Three basal feet free, without lateral wings.

The genus *Cladoscenium* differs from the preceding *Euscenium* only in the ramification of the internal columella, which bears one or more verticils of three ascending lateral branches. The three branches of each verticil lie in the same equidistant meridian planes as the three basal feet, and are inserted with their distal ends on the inner surface of the simple lattice-shell. The three feet are also branched, but without vertical lattice-wings. *Cladoscenium* is perhaps closely allied to *Clathrocorys*.

### 1. *Cladoscenium fulcratum*, n. sp.

Shell subspherical, smooth, with large irregular roundish pores. Basal plate with three large pores. Columella with a single verticil of three ascending lateral branches. Apical horn as long as the

[1] *Cladoscenium*=Small tent with branched axis; κλαδός, σκηνίον.

columella, simple, three-sided prismatic. Feet twice as long, widely divergent, straight, prismatic, with some irregular basal branches.

*Dimensions.*—Shell 0·06 diameter, horn 0·05 long, feet 0·1 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Cladoscenium ancoratum*, n. sp. (Pl. 53, fig. 13).

Shell campanulate, smooth, with irregular polygonal pores. Basal plate with six pores (two large cardinal, two smaller jugular and two still smaller cervical pores). Columella with a single verticil of three ascending lateral branches (by mistake not distinct in the figure). Apical horn and the three feet of the same form and size, slender, prismatic, twice to three times as long as the shell, straight, in the distal half with three slender recurved branches, anchor-shaped.

*Dimensions.*—Shell 0·05 long, 0·04 broad; horn and feet 0·1 to 0·15 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

3. *Cladoscenium gladiatum*, n. sp.

Shell subspherical, with irregular polygonal pores. Basal plate with three large pores. Columella with two verticils of three ascending lateral branches. Apical horn as long as the columella, three-sided prismatic. Feet of the same form, twice as long, in the distal half with two opposite transverse branches, sword-shaped.

*Dimensions.*—Shell 0·05 long, 0·06 broad; horn 0·04 long, feet 0·1 long.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

4. *Cladoscenium pinnatum*, n. sp.

Shell campanulate, with irregular polygonal pores. Basal plate with four pores (two major cardinal and two minor jugular). Columella with two verticils of three ascending lateral branches, and prolonged into a slender prismatic apical horn of twice the length, which bears four such verticils. Feet twice as long as the horn, pinnate, each with four or five pairs of opposite lateral branches, decreasing towards the thin distal end.

*Dimensions.*—Shell 0·06 long, 0·05 broad; horn 0·1 long, feet 0·2 long.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

5. *Cladoscenium verticillatum*, n. sp.

Shell campanulate, with subregular square pores. Basal plate with nine pores (three larger central and six smaller distal). Columella with three verticils of three ascending lateral branches. Apical horn and the three basal feet of equal size and similar form, four to six times as long as the columella, three-sided prismatic, each with four to five verticils of three lateral branches, which are

irregularly ramified and tapering towards the distal end. (Similar to *Clathrocorys teuscheri*, Pl. 64, fig. 10, but with four free spines, without connecting lattice-wings.)

*Dimensions.*—Shell 0·07 long, 0·06 broad; horn and feet 0·2 to 0·25 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

6. *Cladoscenium pectinatum*, n. sp. (Pl. 98, fig. 2).

Shell subspherical, with irregular roundish pores. Basal plate with three large holes. Columella with two verticils of three ascending lateral branches. Apical horn and the three feet of nearly the same size and form, three to four times as long as the columella, straight, three-sided prismatic, each with five to eight verticils of three simple lateral branches, tapering towards the distal end.

*Dimensions.*—Shell 0·07 long, 0·08 broad; horn and feet 0·16 to 0·22 long.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

Genus 506. *Archiscenium*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archiperida (vel Monocyrtida triradiata clausa) with a free simple internal columella, prolonged into an apical horn. Three basal feet connected with the horn by three vertical lateral wings.

The genus *Archiscenium* and the following nearly allied *Pteroscenium* are derived from the two preceding genera, from which they differ in the development of three free vertical lateral lattice-wings; these arise from the upper edge of the three basal feet and connect them with the three edges of the apical horn. The basal part of the latter, enclosed in the shell, forms an internal free columella, which in *Archiscenium* is simple, not branched.

1. *Archiscenium quadrispinum*, n. sp. (Pl. 53, fig. 11).

Shell hemispherical, smooth, with a small number of large irregular polygonal meshes and thin bars. Basal lattice with three very large central meshes and six smaller peripheral meshes (two on the base of each foot). Apical horn and the three feet of equal size and similar form, slender, pyramidal, widely divergent, straight, as long as the shell-diameter. Three lateral wings small, little prominent, each with two or three irregular meshes. Central capsule subspherical.

*Dimensions.*—Shell 0·05 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

2. *Archiscenium clathrocorys*, n. sp.

Shell campanulate, smooth, with numerous irregular square meshes. Basal lattice with three very large meshes. Apical horn and the three feet of equal size and similar form, three-sided prismatic,

[1] *Archiscenium* = Primordial tent; ἀρχί, σκηνίον.

widely divergent, straight, twice as long as the shell-diameter. Three lateral wings broad, each with a basal row of few very large irregular roundish meshes, and several distal rows of small square meshes. This species is very similar to *Clathrocorys murrayi* (Pl. **64**, fig. 8), but has no trace of thorax-wall. The latter species may be derived from the former by development of the thoracic lattice, which connects the three free feet.

*Dimensions.*—Shell 0·05 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Archiscenium tripterygium*, n. sp.

Shell hemispherical, smooth, with numerous irregular roundish meshes of very different sizes. Basal lattice with four large meshes, two major cardinal and two minor cardinal pores. Apical horn and the three feet of similar form and size, slender prismatic, three to four times as long as the shell; the horn straight, the feet curved. Three lateral wings very delicate, with a basal row of few large irregular polygonal meshes, and several distal rows of similar small pores.

*Dimensions.*—Shell 0·04 long, 0·05 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

4. *Archiscenium cyclopterum*, n. sp. (Pl. **98**, fig. 3).

Shell hemispherical, with small irregular roundish pores. Basal lattice with four large meshes, two major cardinal and two minor jugular pores. Apical horn and the three feet of similar form and size, slender prismatic, straight, twice to four times as long as the shell. Three lateral wings nearly semicircular, densely latticed, with the same pores as the shell, and smooth convex margin.

*Dimensions.*—Shell 0·05 long, 0·06 broad.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

5. *Archiscenium callimitra*, n. sp.

Shell campanulate, with irregular polygonal pores. Basal lattice with nine meshes (three larger central and six smaller distal pores, as in *Callimitra carolotæ*, Pl. **63**, fig. 8). Apical horn straight, prismatic, slender, conical, twice as long as the shell. Feet longer and more slender, slightly curved. Three lateral wings very broad, densely fenestrated, with irregular polygonal pores of the same shape as in the similar *Callimitra carolotæ* (Pl. **63**, fig. 1).

*Dimensions.*—Shell 0·05 long, 0·04 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Genus 507. *Pteroscenium*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archiperida (vel Monocyrtida triradiata clausa) with a free branched internal columella, prolonged into an apical horn. Three basal feet connected with the horn by three vertical lateral wings.

[1] *Pteroscenium* = Small tent with wings; πτερόν, σκηνίον.

The genus *Pteroscenium* differs from the preceding *Archiscenium* only in the ramification of the internal columella, and therefore exhibits to it the same relation that *Cladoscenium* bears to *Euscenium*. The branches of the columella form also here verticils of ascending branches, three in each verticil, and their distal ends are inserted on the inner surface of the lattice-shell.

1. *Pteroscenium arcuatum*, n. sp. (Pl. 98, fig. 4).

Shell campanulate, smooth, nearly conical, somewhat broader than long, with irregular dense network of small circular pores. Columella straight, with two or three triradiate verticils of horizontal lateral branches, which are inserted in the shell-wall. Horn slender pyramidal, as long as the shell. Three divergent feet twice as long as the horn, strongly curved, thorny, three-edged; the distance of their pointed ends twice as broad as the shell. From the outer edge of each foot arise numerous ascending bristles, which are connected together and with similar lateral branches of the horn by curved arches, forming three delicate spiny vertical wings.

*Dimensions.*—Shell 0·06 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Pteroscenium arcadophorum*, n. sp.

Shell campanulate, smooth, with irregular polygonal pores, very similar to the preceding species but with much broader wings, forming several arcades with three to five rows of irregular meshes. Columella with five or six triradiate verticils of lateral branches. Horn twice as long as the shell, of the same length as the strongly curved spinulate feet.

*Dimensions.*—Shell 0·09 long, 0·11 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Pteroscenium pinnatum*, n. sp. (Pl. 53, figs. 14, 15, 16).

Shell campanulate, smooth, somewhat longer than broad, with irregular delicate network of small roundish pores. Columella straight, with numerous (eight to twelve) triradiate verticils of ascending lateral branches, which are inserted in the shell-wall. The uppermost end of the columella is a conical apical horn. The three divergent feet are smooth, slender, conical, slightly curved, about as long as the shell, pinnate, with six to ten pairs of ascending lateral branches, parallel to those of the columella and inserted on the three vaulted lateral wings. (Fig. 14 exhibits the outside of the shell, fig. 15 the internal structure of the cortina, fig. 16 the basal view.)

*Dimensions.*—Shell 0·1 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

4. *Pteroscenium spinulosum*, n. sp.

Shell campanulate, spinulate, about as long as broad, with small and numerous irregular polygonal pores, very similar to the preceding species, but differing in the more slender form of

the horn and the feet, bearing more numerous lateral branches (twelve to sixteen pairs on each foot). Columella with six to eight triradiate verticils. Horn about as long as the shell.

*Dimensions.*—Shell 0·1 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

5. *Pteroscenium macropodium*, n. sp.

Shell campanulate, spinulate, with irregular polygonal pores; very similar to the two preceding species, but differing in the size and shape of the three feet, which are for the most part solid, triangular, nearly parallel, vertical, very slender, three times as long as the shell, latticed only at the curved base, with few pairs of lateral branches. Columella with four to six triradiate verticils, as long as the stout triangular pyramidal horn.

*Dimensions.*—Shell 0·1 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

6. *Pteroscenium tripocolpum*, n. sp.

Shell campanulate, spinulate, similar to *Euscenium tricolpium* (Pl. **53**, fig. 12) with three vaulted hemispherical bosoms between the three delicate arachnoidal vertical wings. Network loose, very irregular, with polygonal meshes of very different sizes. Columella with three or four triradiate verticils, as long as the slender pyramidal horn. Three feet twice as long, somewhat curved, widely divergent, with three or four pairs of lateral branches. The three edges of the feet and of the horn are elegantly denticulated.

*Dimensions.*—Shell 0·06 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Genus 508. *Peridium*,[1] Haeckel, 1881, p. 429.

*Definition.*—Archiperida (vel Monocyrtida triradiata clausa) without internal columella, with an apical horn.

The genus *Peridium* (or *Archiperidium*, Prodromus, *loc. cit.*) and the two following nearly allied genera form together the small group of Archibursida, differing from the four preceding genera (the Euscenida) in the absence of an internal free columella. The three basal feet have therefore no direct connection with the apical horn. *Peridium*, the ancestral form of the Archibursida, may have originated either from *Euscenium* by reduction and loss of the columella, or directly from *Tripospyris* by loss of the sagittal ring and the longitudinal constriction.

### Subgenus 1. *Peridarium*, Haeckel.

*Definition.*—Feet smooth, simple, neither spiny nor branched.

[1] *Peridium* = Small pouch; πηρίδιον.

1. *Peridium lasanum*, n. sp.

Shell subspherical, smooth, with subregular circular pores. Basal plate with three large meshes. Horn apical, vertical, of the same size and form as the three divergent smooth feet, slender pyramidal, twice to three times as long as the shell.

*Dimensions.*—Shell-diameter 0·06 to 0·07, length of the three spines 0·15 to 0·2.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

2. *Peridium papillatum*, n. sp.

Shell subspherical, papillate, with subregular circular pores. Basal plate with four meshes (two major cardinal and two minor jugular pores). Horn occipital, oblique, three-sided pyramidal, half as long as the shell and as the three widely divergent, subhorizontal, smooth feet.

*Dimensions.*—Shell diameter 0·07 to 0·08, length of the horn 0·04, of the feet 0·08.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Peridium curvipes*, n. sp.

Shell hemispherical, thorny, with irregular roundish pores. Basal plate with six pores (two larger middle cardinal, two smaller anterior jugular and two smaller posterior cervical pores, as in Pl. 53, figs. 13, 18). Horn conical, oblique, arising from the middle of the occipital face, half as long as the shell. Feet slender, conical, curved, smooth, twice as long as the shell.

*Dimensions.*—Shell 0·04 long, 0·06 broad; horn 0·02 long; feet 0·08 long.

*Habitat.*—Tropical Pacific, Station 206, depth 2100 fathoms.

## Subgenus 2. *Archiperidium*, Haeckel.

*Definition.*—Feet spiny or branched.

4. *Peridium spinipes*, n. sp. (Pl. 53, fig. 9).

Shell ovate, rough or thorny, with irregular roundish pores. Basal plate with four pores (two larger cardinal and two smaller jugular pores). Horn oblique, occipital, three-sided pyramidal, half as long as the shell, connected with the caudal foot by a prominent crest. Three feet horizontally expanded, prismatic, spiny, about as long as the shell.

*Dimensions.*—Shell 0·08 long, 0·06 broad; horn 0·04 long, feet 0·06 to 0·09 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

5. *Peridium palmipes*, n. sp. (Pl. 53, fig. 10).

Shell ovate, smooth, with irregular roundish pores. Basal plate with three large pores. Horn oblique, three-sided pyramidal, about as long as the shell, inserted near its occipital base. Three feet prismatic, slender, half as long, ending with a broad dentate plate.

*Dimensions.*—Shell 0·06 long, 0·05 broad; horn 0·05 long, feet 0·03 long.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

6. *Peridium alatum*, n. sp. (Pl. 97, fig. 7).

Shell subspherical smooth, with regular circular, hexagonally-framed pores. Basal plate with nine pores (three larger central and six smaller distal pores). Horn apical, of equal size and the same form as the three feet, three-sided prismatic, with three broad prominent wings, somewhat longer than the shell.

*Dimensions.*—Shell 0·07 long, 0·08 broad; horn and feet 0·1 to 0·12 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

7. *Peridium cervinum*, n. sp.

Shell subspherical, spiny, with subregular circular pores. Basal plate with four pores (?). Horn apical, conical, about as long as the shell. Feet three to four times as long, cylindrical curved, with irregular simple or forked branches like the antlers of a deer.

*Dimensions.*—Shell diameter 0·1, horn 0·1 long, feet 0·3 to 0·4 long.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Genus 509. *Archipera*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archiperida (vel Monocyrtida triradiata clausa) without internal columella, with two or more apical horns.

The genus *Archipera* differs from the preceding *Peridium* only in the multiplication of the apical horn, which in the latter is always simple. The number of horns is usually two or three, sometimes four or more. The species bearing three horns may be derived directly from *Triceraspyris* by loss of the sagittal ring.

1. *Archipera cortiniscus*, n. sp. (Pl. 98, fig. 5).

Shell ovate, thorny, with large roundish pores, which are closed by sieve-plates with numerous small porules. Basal plate with two pairs of simple large pores (two smaller jugular and two larger cardinal, similar to Pl. 98, fig. 10*b*). Two horns divergent, curved, slender, pyramidal; the apical horn longer than the shell, the frontal horn shorter. Three feet divergent, longer than the shell, three-sided prismatic, at the distal end club-shaped, thorny.

*Dimensions.*—Shell 0·1 long, 0·08 broad; horns and feet 0·11 to 0·14 long.

*Habitat.*—Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Archipera pentacantha*, n. sp.

Shell pear-shaped, smooth, with numerous and small irregular roundish pores. Basal plate with three larger pores. Two horns and three feet of nearly equal size and similar form, three-sided

[1] *Archipera* = Primordial pouch; ἀρχί, πήρα.

prismatic, about as long as the shell diameter, somewhat curved. The apical horn stands on the apex, the frontal horn half-way up the shell.

*Dimensions.*—Shell 0·08 long, 0·06 broad; horns and feet 0·05 to 0·07 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Archipera bicornis*, n. sp.

Shell ovate, rough, with small regular circular, sparsely scattered pores. Basal plate with four larger central and a peripheral coronal of twelve smaller pores. Two horns near the apex widely divergent, somewhat shorter than the shell, of equal size and similar form. Three feet twice as long, horizontally expanded. All five spines slender, three-sided pyramidal, straight.

*Dimensions.*—Shell 0·07 long, 0·06 broad; horns 0·05 long, feet 0·1 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Archipera tricornis*, n. sp.

Shell subspherical, smooth, with subregular circular pores. Basal plate with four large meshes (two major cardinal and two minor jugular pores). On the apex three divergent pyramidal horns of different size, one larger occipital and two smaller frontal horns. Three feet prismatic, about twice as long as the shell.

*Dimensions.*—Shell diameter 0·05, length of the feet 0·1.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

5. *Archipera quadricornis*, n. sp.

Shell ovate, smooth, with a small number of irregular roundish, widely scattered pores. Basal plate with four crossed meshes of nearly equal size. On the equator there arise four divergent prismatic horns of nearly equal size, three of which correspond to the three feet, whilst the fourth is opposite to the caudal foot. The three feet are also prismatic, as long as the shell, horizontally expanded. (Similar to the upper half of *Lithomelissa decacantha*, Pl. 56, fig. 2, but without thorax.)

*Dimensions.*—Shell 0·05 long, 0·04 broad; horns and feet 0·06 long.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

6. *Archipera multicornis*, n. sp.

Shell hemispherical, spiny, with irregular polygonal pores. Basal plate with six meshes (?). Between the smaller spines of the surface arise six larger conical divergent horns. Three feet also conical, divergent, about twice as long as the shell and the horns.

*Dimensions.*—Shell 0·05 long, 0·07 broad; horns 0·05 long, feet 0·1 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Genus 510. *Archibursa*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archiperida (vel Monocyrtida triradiata clausa) without internal columella and without apical horn.

The genus *Archibursa* has probably arisen from *Peridium* by loss of the apical horn, and is the only genus of Archiperida which bears no horn. The three basal feet are well-developed. It differs from the similar *Tristylospyris* by the absence of the sagittal ring and the corresponding longitudinal constriction.

1. *Archibursa tripodiscus*, n. sp. (Pl. 98, fig. 6).

Shell subspherical, smooth, with irregular roundish pores. Basal plate with three large triangular pores of equal size (fig. 6). Three feet widely divergent, straight, three-sided prismatic, about as long as the diameter of the shell.

*Dimensions.*—Diameter of the shell 0·07, length of the feet 0·09.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Family LX. PHÆNOCALPIDA, n. fam.

*Archiphormida* et *Archiphænida*, Haeckel, 1881, Prodromus, pp. 428, 429.

*Definition.*—Monocyrtida multiradiata. (Cyrtoidea with a simple, not jointed shell, resembling a simple cephalis, with numerous radial apophyses (four to nine or more).

The family Phænocalpida, composed of the Archiphormida and Archiphænida of my Prodromus, comprises those Cyrtoidea in which the lattice-shell is quite without transverse constriction, but bears numerous radial apophyses. The two subfamilies differ in the shape of the basal mouth, which in the Archiphormida is a simple wide opening, but is closed in the Archiphænida by a lattice-plate.

Several Phænocalpida were formerly described by Ehrenberg, viz., *Halicalyptra virginica* (in 1844) and *Litharachnium arachnodiscus* (in 1872, called by him *Carpocanium*, though it is quite different from this genus, and closely allied to my *Litharachnium tentorium*, figured in 1862). These forms belong to the Archiphormida (with open mouth). Several fossil Archiphænida (with closed mouth) were figured by Ehrenberg, in 1875, as belonging to *Petalospyris* (*ocellata, carinata, flabellum*), though the absence of the sagittal ring and the corresponding longitudinal constriction demonstrates their character as *Phænocalpis*.

[1] *Archibursa* = Primordial bottle; ἀρχί, βύρσα.

The Phænocalpida are probably an artificial family, composed of three or four (or perhaps more) different groups, which have a quite different origin. The Litharachnida (genera 511–515) and the Haliphormida (genera 516–518) are probably derived from the Sethophormida by loss of the cephalis, the retrograde metamorphosis of which may be observed in all its different stages. The Halicalyptrida (genera 519–521) are perhaps independent of the other Phænocalpida, and may be Archicorida which have produced a corona of teeth around the mouth, without relation to lost radial ribs. The Phænoscenida (*Phænocalpis*, *Phænoscenium*) may be derived from the Euscenida (genera 504–507) by interpolation of interradial feet between the three primary ones, or directly from the Plectoidea. The Calpophænida, on the other hand (*Calpophœna*, *Archiphœna*), may have arisen from the Zygospyrida (*Petalospyris*, *Gorgospyris*) by loss of the sagittal ring and the longitudinal constriction. The phylogeny of the Phænocalpida is therefore a very complicated problem, as yet unsolved.

*Synopsis of the Genera of Phænocalpida.*

| | | | | | |
|---|---|---|---|---|---|
| I. Subfamily Archiphormida. Basal mouth of the shell a simple wide opening. | Radial ribs enclosed in the wall of the shell, usually prolonged into free terminal feet. | Shell slender, pyramidal (without horn). | Shell simple, with simple network, | | 511. *Bathropyramis.* |
| | | | Shell simple, with double network, | | 512. *Cinclopyramis.* |
| | | | Shell double, with an outer mantle, | | 513. *Peripyramis.* |
| | | Shell flatly campanulate or discoidal (without horn). | Radial ribs simple, | | 514. *Litharachnium.* |
| | | | Radial ribs branched, | | 515. *Cladarachnium.* |
| | | Shell ovate, urceolate or campanulate. | Mouth smooth, constricted (no horn), | | 516. *Cyrtophormis.* |
| | | | Mouth with a corona of feet. | With horn, | 517. *Haliphormis.* |
| | | | | No horn, | 518. *Archiphormis.* |
| | No radial ribs in the wall of the shell. Mouth surrounded by a corona of free terminal feet. | | Shell simple without mantle. | With horn, | 519. *Halicalyptra.* |
| | | | | No horn, | 520. *Carpocanistrum.* |
| | | | Shell double, with an external mantle (no horn), | | 521. *Arachnocalpis.* |
| II. Subfamily Archiphænida. Basal mouth closed by a lattice-plate. | In the axis of the shell-cavity a free columella. | | Columella simple, | | 522. *Phænocalpis.* |
| | | | Columella branched, | | 523. *Phænoscenium.* |
| | Shell-cavity simple, without axial columella. | | Apex with a horn, | | 524. *Calpophœna.* |
| | | | No apical horn, | | 525. *Archiphœna.* |

Subfamily 1. ARCHIPHORMIDA, Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Phæncalpida with the basal mouth of the shell open (vel Monocyrtida multiradiata aperta).

Genus 511. *Bathropyramis*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with simple, slender pyramidal shell and numerous radial beams (six to nine or more). Network simple, with large, unfenestrated, quadrangular meshes.

The genus *Bathropyramis* and the following four nearly allied genera form together a peculiar group of Archiphormida, the Litharachnida, possessing near relations to *Sethopyramis* and the allied Sethophormida, from which they are probably derived by reduction and loss of the small cephalis. The shell in all these forms is distinctly pyramidal, composed of numerous divergent radial beams (commonly six to nine), which form the edges of the pyramid, and are connected by parallel horizontal rings. The quadrangular meshes so produced are quite simple in *Bathropyramis*. This genus cannot be sharply separated from *Sethopyramis*, its ancestral form.

Subgenus 1. *Acropyramis*, Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Shell smooth, without spines on the surface.

1. *Bathropyramis acephala*, n. sp.

Shell smooth, slenderly pyramidal, with three cortinar pores at the apex and with six stout radial beams or longitudinal ribs, connected by twelve to sixteen complete hexagonal horizontal rings. Meshes nearly square, increasing gradually in size towards the mouth.

*Dimensions.*—Shell 0·25 long, 0·15 broad.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

2. *Bathropyramis quadrata*, n. sp. (Pl. 54, fig. 1).

Shell smooth, slenderly pyramidal, with three cortinar pores at the apex and nine stout radial beams, connected by eight to twelve complete circular horizontal rings. Meshes subregular, square, increasing on size gradually towards the circular mouth.

*Dimensions.*—Shell 0·2 to 0·3 long, 0·12 to 0·2 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

[1] *Bathropyramis* = Pyramid with ladders; *βάθρον*, *πυραμίς*.

3. *Bathropyramis trapezoides*, n. sp. (Pl. 54, fig. 3).

Shell smooth, broadly pyramidal, with four cortinar pores at the apex and eight (or sometimes nine) stout radial beams, connected by twelve to sixteen complete octagonal horizontal rings. Meshes trapezoidal, of nearly equal length, but gradually increasing in breadth.

*Dimensions.*—Shell 0·3 long, 0·3 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

4. *Bathropyramis interrupta*, n. sp. (Pl. 55, fig. 7).

Shell smooth, flatly pyramidal, nearly discoidal, with four cortinar pores at the apex and nine to ten stout radial beams, connected by eight to sixteen interrupted rings; the rings are complete only in the apical part, in the distal part more or less irregularly interrupted.

*Dimensions.*—Shell 0·12 long, 0·36 broad.

*Habitat.*—North Atlantic, Station 354, surface.

5. *Bathropyramis medusa*, n. sp.

Shell smooth, flatly pyramidal, nearly discoidal, with four cortinar pores and numerous radial beams (thirty to fifty); the four perradial of these are prolongations of the four cortinar beams, and alternate with four interradial of the same size. Between these are intercalated eight adradial beams arising from the third ring; and between the former and the latter, sixteen to twenty-four peripheral radial beams, arising from the fourth to the sixth ring. The inner four to six rings are complete, the outer ten to fifteen irregularly interrupted.

*Dimensions.*—Shell 0·08 long, 0·3 to 0·4 broad.

*Habitat.*—South Atlantic, Station 338, surface.

Subgenus 2. *Cladopyramis*, Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Shell spiny, with prominent simple or branched spines on the surface.

6. *Bathropyramis spinosa*, n. sp.

Shell spiny, slenderly pyramidal, with three cortinar pores at the apex and with nine strong radial beams, connected by fifteen to twenty complete parallel rings. Meshes subregular square, increasing gradually in size. Surface covered with simple, strong conical spines, arising from the nodal points.

*Dimensions.*—Shell 0·24 long, 0·16 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

7. *Bathropyramis ramosa*, n. sp. (Pl. 54, fig. 4).

Shell spiny, slenderly pyramidal, with three cortinar pores at the apex, and with nine (or sometimes eight or ten) strong radial beams, connected by fifteen to eighteen complete parallel rings. Meshes subregular, square, increasing gradually in size. Surface covered with forked or irregularly branched spines, arising from the nodal points.

*Dimensions.*—Shell 0·3 long, 0·17 broad.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

Genus 512. *Cinclopyramis*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with simple, slender, pyramidal shell, and numerous radial beams (six to nine or more). Network double, with a delicate arachnoidal fenestration, filling up the large quadrangular meshes.

The genus *Cinclopyramis* differs from the preceding *Bathropyramis* in the development of a very delicate secondary network, filling up the large quadrangular meshes, which are produced by the crossing of the radial beams and the parallel horizontal rings. It therefore bears the same relation to the preceding genus that *Plectopyramis* does to *Sethopyramis;* it is perhaps derived directly from the former by loss of the small cephalis.

1. *Cinclopyramis cribellum*, n. sp.

*Cinclopyramis cribellum* = "Ladder of lattice-shape," Bury, 1862, Polycystins of Barbados, pl. xii. fig. 6.

Shell slender, pyramidal, with six strong radial ribs, which are connected by twelve to sixteen complete horizontal rings. Meshes trapezoidal, filled up by a very delicate and regular secondary network with square porules (two to four horizontal threads in each larger mesh).

*Dimensions.*—Shell 0·2 to 0·3 long, 0·12 to 0·16 broad.

*Habitat.*—Fossil in Barbados.

2. *Cinclopyramis infundibulum*, n. sp. (Pl. 54, fig. 7).

Shell slender, pyramidal, with nine strong radial ribs, which are connected by eighteen to twenty-four complete horizontal rings. Meshes subregular square, filled up by a very delicate and regular secondary network with square porules (ten to twelve horizontal threads in each larger mesh). Apex of the pyramid with three very small cortinar pores.

*Dimensions.*—Shell 0·3 to 0·4 long, 0·2 to 0·25 broad.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

[1] *Cinclopyramis* = Lattice-pyramid ; κιγκλίς, πυραμίς.

3. *Cinclopyramis lithosestrum*, n. sp.

Shell slender, pyramidal, with twelve strong radial ribs (six primary longer and six secondary shorter) connected by twelve to fifteen interrupted irregular rings. Meshes irregular square or trapezoidal, filled up by a delicate secondary network with irregular polygonal porules.

*Dimensions.*—Shell 0·4 to 0·5 long, 0·2 to 0·3 broad.

*Habitat.*—Fossil in Barbados.

## Genus 513. *Peripyramis*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with double, slenderly pyramidal shell, and numerous radial beams (six to nine or more). Network double, with an external arachnoidal or spongy envelope around the primary lattice-shell.

The genus *Peripyramis* differs from its probable ancestral form, *Bathropyramis*, by development of a delicate external envelope around the primary shell, and therefore bears to it the same relation that *Spongopyramis* among the Dicyrtida does to *Sethopyramis*. It may also be derived directly from the former by loss of the cephalis.

1. *Peripyramis circumtexta*, n. sp. (Pl. 54, fig. 5).

Shell slender, pyramidal, with nine strong radial beams, connected by fifteen to twenty transverse horizontal rings, which are partly complete, partly interrupted. Meshes subregular, square. From the nodal points of the surface there arise branched spines, which at equal distances from it are connected by thin threads, forming a delicate outer arachnoidal shell with large irregular polygonal meshes.

*Dimensions.*—Shell 0·32 long, 0·16 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Peripyramis spongiosa*, n. sp.

Shell slender, pyramidal, with nine strong radial beams, connected by twelve to eighteen irregular interrupted rings. Meshes irregular, square or polygonal. From the whole surface arise numerous branched spines, which by communication and dense ramification form an outer spongy envelope around the shell. (Similar to *Spongopyramis spongiosa*, Pl. 56, fig. 10.)

*Dimensions.*—Shell 0·45 long, 0·32 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

[1] *Peripyramis* = Pyramid with an envelope; περί, πυραμίς.

Genus 514. *Litharachnium*,[1] Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 835.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with flatly conical, tent-shaped or nearly discoidal shell, and numerous, simple, radial beams in its wall.

The genus *Litharachnium*, and the closely allied genus *Cladarachnium*, differ from the preceding similar genera mainly in the flat form of the depressed shell, which is not slenderly pyramidal, but more tent-shaped or nearly discoidal. The radial ribs are generally not straight, but more or less curved. The top of the tent exhibits three or four important meshes, the original pores of the cortinar septum. *Litharachnium* may be derived directly from *Sethophormis* by reduction and loss of the cephalis.

Subgenus 1. *Litharachnidium*, Haeckel.

*Definition.*—Apex with three cortinar pores (one odd sternal and two paired cardinal pores).

1. *Litharachnium tentorium*, Haeckel.

*Litharachnium tentorium*, Haeckel, 1862, Monogr. d. Radiol., p. 281, Taf. iv. figs. 7–10.

Shell flatly conical or tent-shaped, with concave lateral outlines. Apex with three equal cortinar pores. Twenty radial ribs at nearly equal distances. Between them very numerous and thin secondary ribs, crossed by more than one hundred concentric rings. Pores square, as in all the following species. Margin truncate, circular.

*Dimensions.*—Shell 0·35 long, 0·8 broad.

*Habitat.*—Mediterranean (Messina).

2. *Litharachnium araneosum* (Pl. 55, figs. 8, 10).

Shell flatly conical, nearly discoidal, with straight lateral outlines. Apex with three unequal cortinar pores (one odd smaller sternal and two paired larger cardinal pores). Twenty radial ribs at unequal distances, with numerous intercalated secondary ribs. Margin ciliate.

*Dimensions.*—Shell 0·18 long, 0·32 broad.

*Habitat.*—Central Pacific, Station 271, surface.

[1] *Litharachnium*=Spider-web of silex; λιθος, ἀραχνιον.

3. *Litharachnium arachnodiscus*, Haeckel.

*Litharachnium arachnodiscus*, Haeckel, 1862, Monogr. d. Radiol., p. 283.
*Carpocanium arachnodiscus*, Ehrenberg, 1861, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 296; Abhandl. d. k. Akad. d. Wiss. Berlin, 1872, Taf. ii. fig. 8.

Shell flatly campanulate, nearly discoidal, with convex (?) lateral outlines. Apex with three unequal cortinal pores. Nine stronger radial primary ribs complete; between them numerous secondary intercalated ribs (sixty to seventy). Margin ciliate.

*Dimensions.*—Shell 0·03 long, 0·1 broad (?).

*Habitat.*—Arctic Ocean (between Greenland and Iceland), depth 1000 fathoms (Schaffner).

4. *Litharachnium epeira*, n. sp. (Pl. 55, fig. 9).

Shell flatly conical or tent-shaped, with concave lateral outlines. Apex with three unequal cortinar pores. Twelve stronger radial primary ribs complete; between them numerous (twenty-four to thirty-six) thinner secondary, and very numerous (more than one hundred) tertiary ribs. Margin reflexed, like the curved brim of a hat.

*Dimensions.*—Shell 0·12 long, 0·27 broad.

*Habitat.*—Central Pacific, Station 274, surface.

## Subgenus 2. *Litharachnoma*, Haeckel.

*Definition.*—Apex with four cortinar pores (two anterior jugular and two posterior cardinal pores).

5. *Litharachnium discoides*, n. sp.

Shell flat, funnel-shaped, nearly discoidal, with concave outlines. Apex with four unequal cortinar pores (two smaller jugular and two larger cardinal pores). Twelve strong primary or perradial ribs alternating with twelve weaker secondary or interradial ribs; between these there are twenty-four shorter tertiary or adradial ribs, and in the outer flat, discoidal, half of the shell very numerous peripheral radial ribs (more than two hundred to three hundred). Margin flat, discoidal.

*Dimensions.*—Shell about 0·2 long, 1·12 broad.

*Habitat.*—Equatorial Atlantic, Station 347, surface.

6. *Litharachnium pilidium*, n. sp.

Shell flat, hat-shaped, with S-shaped outlines, in the upper half convex, in the lower half concave. Apex with four equal crossed cortinar pores. Thirty primary ribs of equal size; four of them are the prolongations of the four cortinar beams, eight intercalate between these secondary,

and the other eighteen tertiary. Between them very numerous peripheral beams. Margin broad horizontal, reflexed like the brim of a "Bismarck" hat.

*Dimensions.*—Shell 0·17 long, 0·38 broad.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

### Genus 515. *Cladarachnium*,[1] Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with flatly conical, tent-shaped or nearly discoidal shell, and numerous branched radial beams.

The genus *Cladarachnium* differs from the preceding *Litharachnium* only in the ramification of the radial beams, the distal ends of which project over the margin of the shell. Only one species of the genus has been observed.

1. *Cladarachnium ramosum*, n. sp. (Pl. 55, figs. 5, 6).

Shell flatly conical or tent-shaped, with nearly straight lateral outlines; apical part somewhat higher. Apex with three cortinar pores, surrounded by a few girdles of larger pores. From these there arise about twelve to fifteen strong radial beams at unequal distances; these are somewhat curved and irregularly branched. The network between them has irregular polygonal meshes and is more delicate towards the periphery. Margin with twenty-four to thirty irregular indentations or concave excisions, separated by the prominent distal ends of the branched ribs.

*Dimensions.*—Shell 0·16 long, 0·4 broad.

*Habitat.*—Central Pacific, Station 271, surface.

### Genus 516. *Cyrtophormis*,[2] n. gen.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with ovate or urceolate shell and numerous radial ribs in its wall. Mouth more or less constricted, smooth, truncated. Apex without horn.

The genus *Cyrtophormis*, like the preceding genera, exhibits numerous prominent radial or longitudinal ribs in the wall of the urceolate shell; it differs from these in the constricted and truncated mouth, with smooth margin of the peristome.

1. *Cyrtophormis pila*, n. sp. (Pl. 52, fig. 1).

Shell balloon-shaped, subspherical, with twenty denticulate meridional ribs, alternating with twenty longitudinal rows of circular pores, which are twice as broad as the bars. Peristome constricted and then dilated, smooth, half as broad as the shell.

*Dimensions.*—Shell 0·11 long, 0·09 broad; mouth 0·06 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

[1] *Cladarachnium* = Spider-web with branched threads; κλαδός, ἀράχνιον.

[2] *Cyrtophormis* = Fishing-basket; κυρτή, φορμίς.

2. *Cyrtophormis ærostatica*, n. sp. (Pl. 52, figs. 2, 3).

Shell balloon-shaped, subspherical, with twenty smooth meridional ribs, alternating with twenty longitudinal rows of circular pores, of the same breadth as the bars. Peristome constricted, about half as broad as the shell.

*Dimensions.*—Shell 0·09 long, 0·07 broad; mouth 0·03 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Cyrtophormis spiralis*, n. sp. (Pl. 51, fig. 9).

Shell ovate, one and a half times as long as broad, with twenty spirally convoluted, elegantly denticulated ribs, alternating with twenty spiral rows of small circular pores, of about the same breadth as the bars. Peristome constricted, very small, only one-seventh as broad as the shell.

*Dimensions.*—Shell 0·1 long, 0·07 broad; mouth 0·01 broad.

*Habitat.*—West Tropical Pacific, Station 225, depth 4475 fathoms.

4. *Cyrtophormis tabulata* (Pl. 79, fig. 2).

Shell urceolate and tabulate, twice as long as broad, with twenty-five to thirty denticulated longitudinal ribs, crossed by twenty to twenty-four transverse rings. Pores therefore regularly disposed in longitudinal and transverse rows; each pore circular, with a square frame. Peristome constricted, scarcely half as broad as the shell.

*Dimensions.*—Shell 0·2 long, 0·1 broad; mouth 0·04 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

Genus 517. *Haliphormis*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54 (*sensu mutato*).

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with numerous radial ribs in the wall of the campanulate shell, prolonged into free terminal feet. Apex with a horn.

The genus *Haliphormis* (with an apical horn) and the following *Archiphormis* (without a horn) comprise those Archiphormida in which the open mouth is more or less constricted and surrounded by a coronet of radial feet, as terminal prolongations of the radial ribs of its wall. The few forms, upon which Ehrenberg originally founded the genus *Haliphormis*, are partly not recognisable, partly belong to other genera. We therefore give here a new definition of the genus, as stated in my Prodromus, 1881, p. 428.

[1] *Haliphormis*=Sea-basket; ἅλς, φορμίς.

1. *Haliphormis lagena*, n. sp. (Pl. 97, fig. 5)

Shell bottle-shaped, twice as long as broad, tapering towards both ends, with nine longitudinal curved ribs. These are connected by irregular transverse beams, and the quadrangular meshes, so produced, are filled up by irregular, delicate, arachnoidal framework. The constricted mouth is half as broad as the middle part of the shell and surrounded by nine slender convergent feet, the free distal ends of the ribs. The apex bears a small knob with an oblique horn, perhaps the rudimentary cephalis of *Sethamphora* or *Sethopyramis* (?).

*Dimensions.*—Shell 0·6 to 0·7 long, 0·3 to 0·4 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

2. *Haliphormis costata*, n. sp.

Shell campanulate, somewhat longer than broad, with twelve prominent longitudinal ribs, alternating with twelve rows of regular circular pores. Mouth constricted, half as broad as the shell, with twelve long triangular feet, formed by the free distal ends of the ribs. Apical horn short and stout, triangular pyramidal.

*Dimensions.*—Shell 0·12 long, 0·1 broad; mouth 0·07 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 518. *Archiphormis*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with numerous radial ribs in the wall of the campanulate or urceolate shell, prolonged into free terminal feet. Apex without horn.

The genus *Archiphormis* differs from the preceding *Haliphormis*, its probable ancestral form, in the absence of the apical horn. The number of the longitudinal ribs, which are prolonged into terminal feet, is from six to nine or twelve or even more.

1. *Archiphormis cancellata*, Haeckel.

(?) *Halicalyptra cancellata*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 243.

Shell cup-shaped or campanulate, with six prominent ribs, prolonged into six terminal triangular feet, one-third as long as the shell. Ribs connected by five or six transverse horizontal rings; meshes between them rounded squarish. (As Ehrenberg has given no figure of this species, its identity with the Challenger specimen is doubtful.)

*Dimensions.*—Shell 0·08 long, 0·06 broad; mouth 0·04 broad.

*Habitat.*—North Atlantic, Station 353, depth 2965 fathoms.

[1] *Archiphormis* = Primordial-basket; ἀρχί, φορμίς.

2. *Archiphormis campanulata*, n. sp.

Shell campanulate, with nine prominent denticulate ribs, prolonged into nine terminal feet, which are broad, lamellar, truncate, nearly vertical, one-third as long as the shell. Pores between the ribs circular, disposed in nine longitudinal and seven to eight transverse rows.

*Dimensions.*—Shell 0·09 long, 0·1 broad; mouth 0·06 broad.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

3. *Archiphormis urceolata*, n. sp. (Pl. 98, fig. 11).

Shell urceolate, with nine smooth prominent curved ribs, prolonged into nine triangular convergent short feet, scarcely one-sixth as long as the shell. Pores between the ribs in nine regular longitudinal rows, twice or three times as broad as long, quadrangular, eight to twelve pores in each row. Mouth constricted, half as broad as the shell.

*Dimensions.*—Shell 0·13 long, 0·11 broad; mouth 0·06 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

Genus 519. *Halicalyptra*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54 (*sensu emendato*).

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) without radial ribs in the wall of the campanulate or ovate shell. Mouth with a coronet of radial feet. Apex with a horn.

The genus *Halicalyptra* and the two following closely allied genera differ from the preceding Archiphormida in the absence of radial ribs. The multiradiate structure is indicated only by the terminal spines or feet, forming a coronet around the mouth. These feet are either the free ends of reduced ribs, or new productions of the peristome. *Halicalyptra* may be derived from *Calpophæna* and *Petalospyris* by loss of the basal lattice-plate of the cephalis. But it is also possible that it has been derived from *Anthocyrtis* by loss of the cephalis, and that its shell corresponds to the thorax of the latter.

Subgenus 1. *Acrocalpis*, Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Shell smooth, without spines or thorns (other than the feet and the apical horn).

[1] *Halicalyptra* = Sea-veil; ἅλς, καλύπτρα.

1. *Halicalyptra virginica*, Ehrenberg.

*Halicalyptra virginica*, Ehrenberg, 1854, Mikrogeol., Taf. xviii. fig. 110.
*Halicalyptra virginica*, Haeckel, 1862, Monogr. d. Radiol., p. 289.
*Haliomma virginicum*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 71.
*Acrocalpis virginica*, Haeckel, 1881, Prodromus, p. 427.

Shell smooth, campanulate, nearly hemispherical. Pores subregular circular, about as broad as the bars. Horn conical, half as long as the shell. Peristome scarcely constricted, with six conical divergent feet, as long as the horn.

*Dimensions.*—Shell diameter 0·04 to 0·05, length of the feet 0·02.

*Habitat.*—Fossil in tertiary rocks of Barbados and North America (Richmond, Virginia).

2. *Halicalyptra campanula*, n. sp.

*Podocyrtis spinosa*, Bury, 1862, Polycystins of Barbados, pl. xvii. fig. 3.

Shell smooth, campanulate. Pores irregular, roundish, about as broad as the bars. Horn large conical, about as long as the shell. Peristome not constricted, with six large divergent feet, which are as long as the shell, lamellar, with dentate edges.

*Dimensions.*—Shell diameter 0·07, length of the feet 0·07.

*Habitat.*—Fossil in Barbados.

3. *Halicalyptra ampulla*, n. sp.

*Petalospyris foveolata*, var., Bury, 1862, Polycystins of Barbados, pl. ix. fig. 1.

Shell smooth, subspherical, inflate. Pores regular, circular, twice as broad as the bars. Horn slender conical, about as long as the shell. Peristome constricted, with six divergent cylindrical, irregularly curved feet, twice to three times as long as the shell.

*Dimensions.*—Shell diameter 0·12, feet 0·2 to 0·3 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; also fossil in Barbados.

4. *Halicalyptra novena*, n. sp.

Shell smooth, campanulate. Pores irregular, roundish. Horn slender conical, about as long as the shell. Peristome slightly constricted, with nine slender divergent feet of the same length. (Very similar to *Petalospyris foveolata*, Ehrenberg, but without internal columella and ring, with perfectly simple shell-cavity and open mouth.)

*Dimensions.*—Shell 0·09 diameter, feet 0·1 long.

*Habitat.*—Fossil in Barbados.

5. *Halicalyptra petalospyris*, n. sp. (Pl. 98, fig. 12).

Shell smooth, campanulate. Pores small, circular, irregularly scattered. Horn stout, pyramidal, about as long as the shell. Peristome scarcely constricted, with fifteen to twenty broad

lamellar or lanceolate feet, which are twice to three times as long as the shell, parallel and vertical. (Very similar to *Petalospyris flabellum*, &c., Ehrenberg, 1875, *loc. cit.*, Taf. xxii. figs. 6–8, but without any trace of sagittal ring or columella.)

*Dimensions.*—Shell 0·05 to 0·08 diameter, feet 0·15 to 0·25 long.

*Habitat.*—Central Pacific, Stations 266 to 268, depth 2700 to 2900 fathoms.

### Subgenus 2. *Echinocalpis*, Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Shell spiny, covered with numerous spines or thorns (besides the feet and the apical horn).

### 6. *Halicalyptra spinosa*, n. sp.

Shell spiny, ovate, inflate in the apical half. Pores irregular polygonal, four to eight times as broad as the bars. Peristome constricted, half as broad as the shell, with nine slender divergent feet, which like the apical horn are curved, twice to three times as long as the shell and five to ten times as long as the numerous bristles of the surface.

*Dimensions.*—Shell 0·08 long; 0·06 broad; feet 0·15 to 0·25 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 7. *Halicalyptra castanella*, n. sp.

Shell spiny, nearly spherical. Pores irregular roundish. Peristome constricted, scarcely one-third as broad as the shell, with twelve to twenty slender, widely divergent feet, which like the horn are irregularly curved, and longer than the shell. (Very similar to certain forms of the Phæodarium *Castanella*, Pl. **113**, fig. 2.)

*Dimensions.*—Shell 0·13 diameter, feet 0·15 to 0·18 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Genus 520. *Carpocanistrum*,[1] n. gen.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) without radial ribs in the wall of the campanulate or ovate shell. Mouth with a corona of radial feet. Apex without horn.

The genus *Carpocanistrum* differs from the similar preceding *Halicalyptra* in the loss of the apical horn. It is very nearly related to the Dicyrtid *Carpocanium* and may be easily confounded with it. But in the latter the uppermost part of the shell-cavity includes a rudimentary cephalis with a cortinar septum, whilst in *Carpocanistrum*

[1] *Carpocanistrum* = Small fruit-basket; καρπός, κανίστριον.

the cephalis is entirely lost, and the inner cavity quite simple. The number of the feet of the peristome is from nine to twenty, sometimes more. The mouth is commonly more or less constricted.

1. *Carpocanistrum novenum*, n. sp.

Shell ovate, smooth, one and a third times as long as broad. Pores regular circular, hexagonally framed, three times as broad as the bars, eight to ten on the greatest breadth of the shell. Peristome strongly constricted, one-third as broad as the shell, with nine large ovate lamellar, slightly convergent feet.

*Dimensions.*—Shell 0·08 long, 0·06 broad; mouth 0·02 broad.

*Habitat.*—South Atlantic, Station 325, surface.

2. *Carpocanistrum flosculum*, n. sp. (Pl. 52, fig. 9).

Shell campanulate, rough, thick-walled, of equal breadth and length. Pores regular circular, of the same breadth as the bars, twelve to fifteen on the greatest breadth of the shell. Peristome slightly constricted, with twelve elegant lanceolate, nearly vertical, a little convergent feet.

*Dimensions.*—Shell 0·07 long, 0·07 broad; mouth 0·05 broad.

*Habitat.*—Equatorial Atlantic, Station 347, surface.

3. *Carpocanistrum giganteum*, n. sp.

Shell ovate, smooth, very thick-walled, one and a third times as long as broad. Pores very numerous and small, subregular circular, forty to fifty on the greatest breadth of the shell, of about the same breadth as the bars. Peristome small, constricted, scarcely one-fourth as broad as the shell, with twelve to fifteen short triangular vertical feet.

*Dimensions.*—Shell 0·28 to 0·31 long, 0·21 to 0·23 broad; mouth 0·06 to 0·07 broad.

*Habitat.*—Fossil in Barbados.

4. *Carpocanistrum acephalum*, n. sp. (Pl. 52, fig. 10).

Shell ovate, smooth, thin-walled, one and a fifth times as long as broad. Pores subregular circular, twice as broad as the bars, sixteen to twenty on the greatest breadth of the shell. Peristome slightly constricted, with fifteen to eighteen slender, slightly bent, nearly vertical, and parallel feet, which are half as long as the shell.

*Dimensions.*—Shell 0·12 long, 0·1 broad; mouth 0·07 broad.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

5. *Carpocanistrum evacuatum*, n. sp. (Pl. 52, fig. 11).

Shell urceolate, smooth, thin-walled, one and a half times as long as broad. Pores regular circular, sixteen to twenty on the greatest breadth of the shell. Peristome slightly constricted, with twenty to twenty-five small triangular vertical feet.

*Dimensions.*—Shell 0·1 long, 0·07 broad; mouth 0·05 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

6. *Carpocanistrum pyriforme*, Haeckel.

*Lithocarpium pyriforme*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 97, Taf. iii. fig. 10.

Shell pear-shaped or subspherical, one and a fourth times as long as broad. Pores roundish, polygonally framed (or with square meshes ?). Peristome strongly constricted, one-fourth as broad as the shell, somewhat tubular, with twelve to twenty short vertical and parallel feet. The position of this species is doubtful; perhaps it represents a peculiar genus.

*Dimensions.*—Shell 0·17 long, 0·14 broad; mouth 0·035 broad.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte) Stöhr.

## Genus 521. *Arachnocalpis*,[1] Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Archiphormida (vel Monocyrtida multiradiata aperta) with an ellipsoidal or nearly spherical double shell; outer shell arachnoidal or spongy. Peristome small, constricted, with a corona of numerous radial feet. No apical horn.

The genus *Arachnocalpis* differs from the other Archiphormida by possessing a double shell (like *Peripyramis*). The large shell, reaching nearly half a millimeter in length, is either ellipsoidal or nearly spherical, and composed of an inner primary and an outer secondary shell. Its network is very delicate, in the outer envelope either spongy or arachnoidal. This very remarkable genus has probably no true relation to the other Archiphormida, but has been derived from true Calpoidea (*Mitrocalpis*) by development of a corona around the mouth.

1. *Arachnocalpis ellipsoides*, n. sp. (Pl. 98, fig. 13).

Shell ellipsoidal, one and a half times as long as broad, on the apical pole hemispherical, on the basal pole coronate, with an elegant prominent funnel-shaped peristome, which is one-eighth as broad as the shell, fenestrated by very fine pores, and bears fifteen to twenty short conical divergent teeth. Inner shell with irregular polygonal meshes of very different size, separated by thin, finely-

[1] *Arachnocalpis* = Urn enveloped by spider's web; ἀράχνη, καλπίς.

denticulate bars. Outer spongy shell very delicate, arachnoidal, with numerous prominent conical spongy papillæ. Central capsule ellipsoidal, half as long and broad as the shell.

*Dimensions.*—Shell 0·46 long, 0·32 broad; mouth 0·045 broad.

*Habitat.*—Central Pacific, Stations 271 to 274, surface.

2. *Arachnocalpis sphæroides*, n. sp.

Shell spheroidal, of the same structure as the preceding ellipsoidal species, with the same form of the spongy envelope; differing from it in the globose form and the shorter peristome, bearing only nine or ten small conical divergent teeth. Central capsule spherical.

*Dimensions.*—Shell 0·3 diameter, mouth 0·04 broad.

*Habitat.*—Central Pacific, Stations 265 to 270, surface.

## Subfamily 2. ARCHIPHÆNIDA, Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Phænocalpida with the basal mouth of the shell fenestrated (vel Monocyrtida multiradiata clausa).

### Genus 522. *Phænocalpis*,[1] n. gen.

*Definition.*—Archiperida (vel Monocyrtida multiradiata clausa) with an internal axial simple columella, prolonged outside into an apical horn.

The genus *Phænocalpis* and the following *Phænoscenium* comprise those Archiphænida in which the vertical axis of the shell-cavity is occupied by a simple or branched columella, arising from the centre of the base and prolonged into an apical horn. This columella may be either the vertical rod of a *Plectaniscus* or the remnant of an original ring of *Petalospyris*. The latter genus differs by its sagittal constriction.

1. *Phænocalpis petalospyris*, n. sp. (Pl. 97, fig. 4).

Shell subspherical, rough, with irregular, roundish pores, larger than the bars. Columella straight, central, thin, prolonged into a large apical horn with three dentate edges. Six basal feet curved, divergent, lamellar, with a middle rib and dentate edges.

*Dimensions.*—Shell 0·07 long, 0·05 broad; horn and feet 0·06 long.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

[1] *Phænocalpis* = Urceolate shell; φαίνα, κάλπις.

2. *Phœnocalpis ocellata*, Haeckel.

*Petalospyris ocellata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xxii. fig. 9.

Shell subspherical, smooth, with irregular roundish pores, about as broad as the bars. Columella slightly curved and excentric, prolonged into a slender conical horn of the same length. Six basal feet similar to the horn, slightly divergent.

*Dimensions.*—Shell 0·06 long, 0·07 broad; horn and feet 0·05 long.

*Habitat.*—Fossil in Barbados.

3. *Phœnocalpis carinata*, Haeckel.

*Petalospyris carinata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xxii. fig. 6.

Shell campanulate, rough, with irregular roundish pores, smaller than the bars. Columella straight, central, prolonged into a stout conical horn of the same length. Nine basal feet slender, triangular, longer than the shell, nearly vertical, with a middle rib in the basal half.

*Dimensions.*—Shell 0·05 long, 0·06 broad; horn 0·04 long, feet 0·08 long.

*Habitat.*—Fossil in Barbados.

4. *Phœnocalpis flabellum*, Haeckel.

*Petalospyris flabellum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, Taf. xxii. fig. 7.

Shell campanulate smooth, with very small circular pores, half as broad as the bars. Columella straight, central, prolonged into a pyramidal horn of half the length. Twelve to fifteen basal feet lamellar, linear, twice to three times as long as the shell, parallel and vertical, pointed at the distal end.

*Dimensions.*—Shell 0·04 long, 0·05 broad; horn 0·02 long, feet 0·1 to 0·12 long.

*Habitat.*—Fossil in Barbados.

## Genus 523. *Phœnoscenium*,[1] n. gen.

*Definition.*—Archiphænida (vel Monocyrtida multiradiata clausa) with an internal axial branched columella, prolonged outside into an apical horn.

The genus *Phœnoscenium* differs from the preceding *Phœnocalpis* in the branched columella, which is connected by three or six ascending branches with the inner wall of the shell. It bears therefore to the latter the same relation that *Cladoscenium* exhibits to *Euscenium*. The former genera may have been derived from the latter by interpolation of new interradial feet between the three primary perradial feet.

[1] *Phœnoscenium* = Tent-shaped shell; φαίνω, σκηνίον.

1. *Phænoscenium hexapodium*, n. sp. (Pl. 98, fig. 9).

Shell campanulate, smooth, about as long as broad. Network delicate, with irregular polygonal pores and thin bars. Columella with four to six ascending three-branched verticils, prolonged into the conical hollow apical horn (with six to eight smaller verticils) which is about as long as the shell. Six basal feet curved, divergent, of the same length, with pinnate middle rod.

*Dimensions.*—Shell 0·1 long, 0·11 broad; horn and feet 0·08 to 0·09 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Phænoscenium cladopodium*, n. sp.

Shell campanulate, conical, smooth, somewhat broader than long. Network with irregular roundish pores, about as broad as the bars. Columella with a single verticil of three ascending branches. Horn pyramidal, stout, as long as the shell, with three dentate edges. Six feet divergent, slightly curved, very unequal; three primary (or perradial) very large, longer than the shell, three-sided pyramidal, with three dentate edges; three secondary (or interradial) much smaller, simple, shorter than the shell.

*Dimensions.*—Shell 0·05 long, 0·06 broad; horn and feet 0·04 to 0·07 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Phænoscenium polypodium*, n. sp.

Shell subspherical, about as long as broad, smooth. Network with regular circular pores, twice as broad as the bars. Columella with two verticils of three ascending branches, prolonged into a stout conical horn of twice the length. Twelve to fifteen conical curved divergent feet, about as long as the shell. The three primary feet are directly connected with the base of the columella.

*Dimensions.*—Shell 0·08 diameter, horn 0·15 long, feet 0·07 to 0·09 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Genus 524. *Calpophæna*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archiphænida (vel Monocyrtida multiradiata clausa) with an apical horn and simple internal cavity of the shell, without axial columella.

The genus *Calpophæna* and the following closely allied *Archiphæna* differ from the two preceding genera of Archiphænida in the simple shell cavity, which encloses no columella. They may be derived either from the preceding *Phænocalpis* by loss of the columella, or directly from the Zygospyrida by reduction of the sagittal constriction and loss of the primary ring. Different subgenera may be distinguished in *Calpophæna* according either to the number of the feet or to their shape (being simple or branched).

[1] *Calpophæna*=Urceolate shell; καλπίς, φαῖνα.

Subgenus 1. *Acrocorona*, Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Feet simple, not branched nor forked.

1. *Calpophæna tetrarrhabda*, n. sp.

Shell subspherical, tuberculate, with subregular circular pores. Apical horn conical, about as long as the shell. Basal plate with a regular cross of four equal cortinar pores, separated by four bars; these are crossed in the sagittal and frontal diameter, and prolonged into four equal conical divergent feet, about as long as the shell.

*Dimensions.*—Shell 0·1 diameter, horn and feet 0·1 to 0·12 long.

*Habitat.*—South Pacific, Station 297, depth 1775 fathoms.

2. *Calpophæna hexarrhabda*, n. sp. (Pl. 53, figs. 17, 18).

Shell subspherical, rough, with irregular roundish pores. Apical horn conical, shorter than the shell. Basal plate (fig. 18) with three pairs of triangular pores, two larger (cardinal) pores in the middle, two smaller (cervical) at the dorsal, and two intermediate (jugular) at the ventral side. The bars between them are prolonged into six equal cylindrical divergent feet, nearly as long as the shell, provided with a spiny knob at the end.

*Dimensions.*—Shell 0·09 long, 0·08 broad; horn and feet 0·06 to 0·08 long.

*Habitat.*—Tropical Pacific, Station 224, depth 1850 fathoms.

3. *Calpophæna ennearrhabda*, n. sp.

Shell subspherical, spiny, with irregular, roundish pores. Apical horn cylindrical, longer than the shell. Basal plate with nine collar pores, three larger central alternating with three pairs of smaller peripheral (like Pl. 87, fig. 2). Corona with nine slender cylindrical, slightly curved, divergent feet, somewhat longer than the shell.

*Dimensions.*—Shell 0·11 long, 0·1 broad; horn and feet 0·12 to 0·15 long.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

4. *Calpophæna enneaphylla*, n. sp.

Shell ovate, smooth, with regular circular pores. Apical horn pyramidal, half as long as the shell. (Basal plate with four cortinar pores?) Corona with nine broad, lamellar, truncate, vertical feet, about as long as the horn.

*Dimensions.*—Shell 0·12 long, 0·09 broad; horn and feet 0·06 long.

*Habitat.*—Central Pacific, Station 271, surface.

5. *Calpophæna petalospyris*, n. sp.

Shell campanulate, tuberculate, with irregular, roundish pores. Apical horn conical, shorter than the shell. (Basal plate with nine pores?) Corona with twelve to twenty broad, lamellar, truncate, vertical feet, of different sizes, somewhat irregular.

*Dimensions.*—Shell 0·08 long, 0·09 broad; horn and feet 0·07 to 0·12 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

Subgenus 2. *Cladocorona*, Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Feet branched or forked.

6. *Calpophæna tetracorethra*, n. sp.

Shell subspherical, smooth, with irregular, roundish pores. Basal plate with four larger pores. Apical horn and the four divergent basal feet of equal size and similar form, three to four times as long as the shell, slender, bristle-shaped, curved, in the distal half irregularly branched. (Very similar to the remarkable *Tetraspyris tetracorethra*, Pl. **53**, figs. 19, 20, but with shorter appendages and with simple spherical shell, which exhibits no trace of sagittal ring and constriction.)

*Dimensions.*—Shell 0·12 diameter, horn and feet 0·3 to 0·5 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

7. *Calpophæna hexacorethra*, n. sp.

Shell subspherical, smooth, similar to the preceding species. Basal plate with six pores. Apical horn and the six divergent feet twice to three times as long as the shell, bristle-shaped, irregularly curved and branched. (Similar to *Hexaspyris hexacorethra*, Pl. **95**, fig. 8, but without sagittal ring and constriction.)

*Dimensions.*—Shell 0·11 long, 0·13 broad; horn and feet 0·2 to 0·3 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Genus 525. *Archiphæna*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archiphænida (vel Monocyrtida multiradiata clausa), with simple internal cavity of the shell, without apical horn and axial columella.

The genus *Archiphæna* has the same simple cavity of the shell as the preceding *Calpophæna*, but differs from it in the loss of the apical horn. It bears therefore to the latter the same relation that *Gorgospyris* does to *Petalospyris*. The two former genera may be derived from the two latter by loss of the sagittal ring and constriction.

[1] *Archiphæna* = Primordial shell; ἀρχί, φαῖνα.

### Subgenus 1. *Coronoplæna*, Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Feet simple, not branched nor forked.

1. *Archiphæna gorgospyris*, n. sp. (Pl. 98, figs. 10, 10*a*).

Shell hemispherical, smooth, with small subregular, circular pores. Collar septum with four large pores (fig. 10*a*). Twelve to fifteen feet, divergent, lamellar, truncate, about as long as the shell. (Similar to certain forms of *Gorgospyris*, Pl. 87, figs. 1 to 3, but with simple shell cavity, without sagittal ring and constriction, and without a columella.)

*Dimensions.*—Shell 0·08 long, 0·04 broad; feet 0·03 to 0·04 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

2. *Archiphæna corona*, n. sp.

Shell crown-shaped, somewhat broader than long, at the base flattened, papillate, with irregular roundish pores. Twenty to twenty-five feet, broad, lamellar, truncate, nearly vertical, about twice as long as the shell.

*Dimensions.*—Shell 0·1 long, 0·12 broad; feet 0·2 to 0·22 long.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

### Subgenus 2. *Stephanophæna*, Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Feet branched or forked.

3. *Archiphæna stephanoma*, n. sp.

Shell campanulate, somewhat longer than broad, with subregular, circular pores. Margin of the flattened base with a corona of about twenty unequal feet, which are partly simple, partly irregularly branched, and about as long as the shell.

*Dimensions.*—Shell 0·11 long, 0·03 broad; feet 0·08 to 0·12 long.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Family LXI. Cyrtocalpida, n. fam.

Archicorida et Archicapsida, Haeckel, 1881, Prodromus, pp. 427, 428.

*Definition.*—Monocyrtida eradiata. (Cyrtoidea with a simple, not jointed shell, representing a simple cephalis without radial apophyses.)

The family Cyrtocalpida, composed of the Archicorida and Archicapsida of my

Prodromus, comprises those Cyrtoidea in which the lattice-shell is quite simple, without transverse constriction, and without radial apophyses. The two subfamilies differ in the shape of the basal mouth, which in the Archicorida is a simple wide opening, but in the Archicapsida is closed by a lattice-plate.

Only a few species of this family were formerly known. Ehrenberg, in 1838, founded upon these the genus *Cornutella*, one of the three oldest genera of Polycystina (*Cornutella, Lithocampe, Haliomma*). In 1862 I described some living forms, with a central capsule, as *Cyrtocalpis*. The Challenger collection contains a large number of new genera and species.

Probably the family Cyrtocalpida is an artificial group, comprising two or more different subfamilies of very different origin. The Cornutellida (*Cornutella, Cornutanna*) have probably been derived from the Sethocorida by loss of the cephalis, so that their conical shell represents a thorax alone. The Mitrocalpida on the other hand (genera 528–531) may be originally simple ovate shells (like *Gromia* and *Lecythium*), arising independently from the Nassellida. The Archicapsida (*Halicapsa, Archicapsa*) are probably derived from the Zygospyrida (*Dictyospyris, Circospyris*) by loss of the sagittal ring and constriction. This is nearly certain, when the three or four typical cortinar pores appear in their basal plate. Some forms of *Halicapsa* may be easily confounded with some forms of Prunoidea (*Lithapium*).

Those Cyrtocalpida, which possess a central capsule with three or four lobes, are probably derived from Tripocyrtida by loss of the three feet, or from Sethocyrtida by loss of the cephalis, since the lobes indicate the original presence of cortinar pores and of a cephalis. Those Cyrtocalpida, however, in which a simple ovate shell encloses a simple central capsule without lobes, may be original "Monocyrtida eradiata," without relation to any radial ancestral forms.

*Synopsis of the Genera of Cyrtocalpida.*

| | | | | | |
|---|---|---|---|---|---|
| I. Subfamily Archicorida. Basal mouth of the shell a simple wide opening. | Shell with simple lattice-work (not double or spongy). | Shell conical, gradually dilated towards the mouth. | With horn, | 526. | *Cornutella.* |
| | | | No horn, | 527. | *Cornutanna.* |
| | | Shell ovate or urceolate, with constricted mouth. | With horn, | 528. | *Archicorys.* |
| | | | No horn, | 529. | *Cyrtocalpis.* |
| | Shell not simply latticed. | Shell ovate, double, with an external mantle, | | 530. | *Mitrocalpis.* |
| | | Shell ovate, with spongy irregular lattice-work, | | 531. | *Spongocyrtis.* |
| II. Subfamily Archicapsida. Mouth closed by a lattice plate. | Shell with an apical horn, | | | 532. | *Halicapsa.* |
| | Shell without horn on the apex, | | | 533. | *Archicapsa.* |

Subfamily 1. ARCHICORIDA, Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Cyrtocalpida, with the basal mouth of the shell open (vel Monocyrtida eradiata aperta).

Genus 526. *Cornutella*,[1] Ehrenberg, 1838, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 128.

*Definition.*—Archicorida with conical shell, gradually dilated towards the wide open mouth. Apex armed with a horn.

The genus *Cornutella* is one of the three oldest genera of Polycystina, described by Ehrenberg, in 1838 (*Cornutella*, *Lithocampe*, and *Haliomma*). He afterwards enumerated, in 1872 and 1875, a large number of fossil and living species, the majority of which, however, belong to other genera of Monocyrtida and Dicyrtida (at least six or seven different genera). We retain here as the true type of the genus the oldest known species:—*Cornutella clathrata*, and the nearly allied forms *Cornutella stylophæna*, *Cornutella mitra*, *Cornutella circularis*, &c. The simple conical shell exhibits no distinct trace of an original cephalis, excepting the apical horn; it may have originated either independently, or been derived from *Sethoconus*, by loss of the cephalis.

Subgenus 1. *Cornutellium*, Haeckel.

*Definition.*—Axis of the conical shell straight. Pores polygonal, or roundish with polygonal frames.

1. *Cornutella hexagona*, n. sp. (Pl. 54, fig. 9).

Shell slender, conical, with straight outlines. Pores subregular, hexagonal, gradually increasing in size towards the mouth; in about ten to twelve longitudinal series, in the upper part very small. Horn slenderly conical, nearly bristle-shaped, long.

*Dimensions.*—Shell 0·1 to 0·15 long, 0·04 to 0·06 broad.

*Habitat.*—Central Pacific, Stations 265 to 274, surface, and at different depths.

2. *Cornutella sethoconus*, n. sp. (Pl. 54, fig. 10).

Shell slender, conical, with undulate outlines. Pores subregular, hexagonal, gradually increasing in size towards the mouth, in about fifteen to eighteen longitudinal series, in the upper part circular. Horn small, conical, short. The network is not so delicate as in the preceding similar species.

*Dimensions.*—Shell 0·12 to 0·16 long, 0·06 to 0·08 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

[1] *Cornutella*=Small horn; diminutive of cornu.

3. *Cornutella distenta*, Ehrenberg.

*Cornutella distenta*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. vi. III. fig. 3.

Shell slender, conical, with straight outlines. Pores small, circular, regularly disposed in six to eight alternating longitudinal rows, each pore surrounded by a large rhombic frame. The connected frames form together a regular rhombic framework with obliquely crossed crests. Horn conical, stout, large.

*Dimensions.*—Shell 0·1 to 0·15 long, 0·04 to 0·06 broad.

*Habitat.*—North Pacific, Californian Sea, depth 2600 fathoms, Ehrenberg.

4. *Cornutella stiligera*, Ehrenberg.

*Cornutella stiligera*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 1; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 68, Taf. ii. fig. 3.

Shell slender, conical, with straight outlines. Pores subregular, rhombic or nearly square, disposed in oblique series, separated by parallel obliquely ascending rings, which are crossed by interrupted parallel bars. Horn slenderly conical or bristle-shaped, thin and long.

*Dimensions.*—Shell 0·08 to 0·12 long, 0·03 to 0·04 long.

*Habitat.*—Fossil in Barbados.

Subgenus 2. *Cornutissa*, Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Axis of the conical shell straight. Pores circular or roundish, without polygonal frames.

5. *Cornutella circularis*, Ehrenberg.

*Cornutella circularis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 4.

Shell wide, conical or funnel-shaped, with straight outlines. Pores very large, circular, ten to twenty times as broad as the bars, in about nine to twelve longitudinal alternating rows, increasing gradually towards the mouth. Horn very large, cylindrical.

*Dimensions.*—Shell 0·1 to 0·15 long, 0·08 to 0·12 broad.

*Habitat.*—Fossil in Barbados.

6. *Cornutella mitra*, Ehrenberg.

*Cornutella mitra*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 8.

Shell wide, conical, campanulate, with convex outlines. Pores subregular, circular, nearly equal in size, not regularly disposed in rows. Horn conical, stout.

*Dimensions.*—Shell 0·12 to 0·16 long, 0·08 to 0·12 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

### 7. *Cornutella clathrata*, Ehrenberg.

*Cornutella clathrata*, Ehrenberg, 1838, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 129; Mikrogeol., Taf. xxii. fig. 39.
*Cornutella clathrata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, Taf. ii. fig. 9.

Shell wide, conical, with slightly convex outlines. Pores regular, circular, gradually increasing in size towards the mouth, disposed in twelve to fifteen longitudinal alternating rows. Horn short and stout, conical. (Compare *Cornutella curvata.*)

*Dimensions.*—Shell 0·15 to 0·2 long, 0·06 to 0·09 broad.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific; also fossil in tertiary rocks of Barbados, Nikobar and Sicily.

### 8. *Cornutella stylophœna*, Ehrenberg.

*Cornutella stylophœna*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. vi. III. fig. 1.
*? Cornutella tumens*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. vi. III. fig. 4.

Shell slender, conical, with undulate outlines. Pores subregular, circular, gradually increasing in size, disposed in six to nine quincuncial alternating longitudinal rows. Horn very long, cylindro-conical, sometimes about as long as the shell.

*Dimensions.*—Shell 0·1 to 0·13 long, 0·04 to 0·06 broad.

*Habitat.*—North Pacific, Californian Sea, depth 2600 fathoms.

### 9. *Cornutella granulata*, Ehrenberg.

*Cornutella granulata*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. vi. III. fig. 3.

Shell slender, conical, nearly cylindrical, with straight outlines, rounded at the apex. Pores very small and numerous, punctiform, disposed into very numerous parallel transverse rows. Horn small, conical (may be perhaps the shell of a Tintinnoid Infusorium ?).

*Dimensions.*—Shell 0·08 long, 0·02 broad.

*Habitat.*—North Pacific, Californian Sea, depth 2600 fathoms.

### 10. *Cornutella annulata*, Ehrenberg.

*Cornutella annulata*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. ii. fig. 16.

Shell slender, conical, nearly cylindrical, with straight outlines, rounded at the apex. Pores small and numerous, regular circular, of equal size, regularly disposed in ten to fifteen parallel transverse series. Horn bristle-shaped. (Compare *Artostrobus annulatus, Cornutella annulata*, Bailey.)

*Dimensions.*—Shell 0·1 to 0·13 long, 0·03 to 0·04 broad.

*Habitat.*—Cosmopolitan, Atlantic, Pacific, surface.

Subgenus 3. *Cornutosa*, Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Axis of the conical shell curved. Pores circular or roundish.

11. *Cornutella curvata*, Haeckel.

*Cornutella clathrata*, var., Ehrenberg, 1854, Mikrogeol., Taf. xxii. figs. 39*a*, *b*, *c*.
*Cornutosa clathrata*, Haeckel, 1881, Prodromus, p. 427.

Shell slender, conical, with curved axis; the curve lies in one plane and is not spirally convoluted. Pores subregular, circular, of nearly equal size, quincuncially disposed. Horn short, conical.

*Dimensions.*—Shell 0·1 to 0·15 long, 0·04 to 0·06 broad.

*Habitat.*—Fossil in tertiary rocks of Sicily (Caltanisetta).

12. *Cornutella spiralis*, n. sp.

*Cornutura spiralis*, Haeckel, 1881, Prodromus, p. 427.

Shell slender, conical, nearly cylindrical, very long, spirally contorted; its axis is an ascending spiral line with two or three windings, widely distant. Pores irregular, square, small and numerous.

*Dimensions.*—Shell 0·2 to 0·25 long, 0·05 to 0·08 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 527. *Cornutanna*,[1] Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Archicorida with conical shell, gradually dilated towards the wide open mouth. Apex without horn.

The genus *Cornutanna* has the same simple conical shell as the preceding *Cornutella*, but differs from it in the total absence of an apical horn. It bears therefore to the latter the same relation that *Cyrtocalpis* does to *Archicorys*. It may be derived from *Sethoconus* by complete reduction of the cephalis and its horn.

1. *Cornutanna orthoconus*, n. sp.

Shell slender, conical, with straight axis and straight outlines. Pores subregular, circular, quincuncially disposed in nine to twelve alternating longitudinal series, gradually increasing in size towards the mouth.

*Dimensions.*—Shell 0·1 to 0·12 long. 0·03 to 0·04 broad.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

[1] *Cornutanna*=Horn-shaped; *Cornuta*.

2. *Cornutanna cyrtoconus*, n. sp.

Shell slender, conical, with curved axis; the curve lies in one plane as in the similar *Cornutella curvata;* the pores are smaller and more numerous than in this latter species, and the rounded apex bears no horn.

*Dimensions.*—Shell 0·12 to 0·16 long, 0·05 to 0·07 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

3. *Cornutanna loxoconus*, n. sp.

Shell wide, conical, with irregularly curved axis; the parts of the curve do not lie in one plane. Pores very small and numerous, of nearly equal size.

*Dimensions.*—Shell 0·2 long, 0·12 broad.

*Habitat.*—Tropical Pacific, Station 225, depth 4475 fathoms.

## Genus 528. *Archicorys*,[1] Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Archicorida with simple urceolate or ovate shell, constricted towards the mouth. Apex armed with a horn.

The genus *Archicorys* and the following closely allied *Cyrtocalpis* differ from the two preceding genera in the ovate or urceolate form of the shell, which is more or less constricted towards the terminal mouth. The upper pole in *Archicorys* bears an apical horn, which is absent in *Cyrtocalpis*. The origin of these two genera may be the same, probably arising directly from Nassellida, and independently of the triradiate Cyrtoidea or bilocular Spyroidea. (Compare p. 1179.)

1. *Archicorys galea*, n. sp.

Shell smooth urceolate. Pores large, in the middle part hexagonal, towards both ends smaller and polygonal. Apical horn stout, three-sided pyramidal, half as long as the shell. Mouth with a short tubular peristome, about one-third as broad as the shell.

*Dimensions.*—Shell (without horn) 0·15 long, 0·12 broad; horn 0·07 long, mouth 0·05 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Archicorys ampulla*, n. sp.

Shell smooth, thin-walled, bottle-shaped, in the upper half conical, in the lower half inflate, subspherical. Pores subregular, circular, of the same breadth as the bars. Horn conical, stout,

[1] *Archicorys* = Principal helm; ἀρχίκορυς.

about one-third as long as the shell. Mouth truncate, without peristome, about half as broad as the shell.

*Dimensions.*—Shell 0·15 long, 0·1 broad; horn 0·05, mouth 0·05.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Archicorys microstoma*, n. sp. (Pl. 51, fig. 12).

Shell rough, thick-walled, ovate. Pores large, subregular, circular, twice to four times as broad as the bars. Horn small, conical, not larger than one pore. Mouth very small, truncate, scarcely larger than one pore.

*Dimensions.*—Shell 0·1 long, 0·07 broad; horn 0·012, mouth 0·015.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

4. *Archicorys globosa*, n. sp.

Shell nearly spherical, thorny, thick-walled. Pores very large, circular, separated by spinulate frames, smaller towards each pole. Horn conical, large, nearly as long as the radius of the shell; mouth truncate, simple, about one-third as broad as the shell.

*Dimensions.*—Shell diameter 0·13, horn 0·06, mouth 0·04.

*Habitat.*—Fossil in Barbados.

5. *Archicorys ovata*, n. sp. (Pl. 51, fig. 10).

Shell ovate, rough, thick-walled. Pores regular, circular, of equal size, very small and numerous, quincuncially disposed. Horn small, conical, sometimes (as in the figured specimen) rudimentary. When it becomes lost, the species may be called *Cyrtocalpis ovata*. Mouth truncate, small, simple, one-sixth as broad as the shell.

*Dimensions.*—Shell 0·2 long, 0·15 broad; horn 0·01 to 0·03 long, mouth 0·03 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

Genus 529. *Cyrtocalpis*,[1] Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 835.

*Definition.*—Archicorida with simple urceolate or ovate shell, constricted towards the mouth. Apex without horn.

The genus *Cyrtocalpis* comprises a large number of common, very primitive Monocyrtida, which in the simple ovate or urceolate form of the shell resemble the well known *Gromia* among the Thalamophora. Its basal mouth is more or less constricted, as in

[1] *Cyrtocalpis*=Basket-urn or wicker-pitcher; κύρτος, καλπίς.

the preceding genus *Archicorys*, from which it differs in the total absence of an apical horn. There is no trace of any triradial structure, excepting in some smaller species, in which the basal part of the central capsule is trilobate; these may be derived from the Dicyrtides *Sethocorys* or *Dictyocephalus*, by loss of the cephalis and the cortinar septum. But the larger species, which have a quite simple, ovate, central capsule (Pl. 51, fig. 13), have probably an independent origin, from *Cystidium*.

1. *Cyrtocalpis urceolus*, n. sp. (Pl. 51, fig. 13).

Shell smooth, urceolate, with very delicate and elegant network. Pores in the middle part large, regular, hexagonal, towards each pole smaller, irregular, roundish or polygonal. Mouth with broad, hyaline, annular peristome, about one-third as broad as the shell.

*Dimensions.*—Shell 0·16 long, 0·12 broad; mouth 0·05 broad.

*Habitat.*—Mediterranean (Portofino near Genoa), surface.

2. *Cyrtocalpis reticulum*, n. sp.

Shell smooth, urceolate, very similar to the preceding species, but differing from it in the densely reticulated framework of the shell, which is composed of very numerous and small, irregular, polygonal meshes of nearly equal size. Mouth without peristome, half as broad as the shell.

*Dimensions.*—Shell 0·18 long, 0·15 broad; mouth 0·07 broad.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

3. *Cyrtocalpis amphora*, Haeckel.

*Cyrtocalpis amphora*, Haeckel, 1862, Monogr. d. Radiol., p. 286, Taf. v. fig. 2.

Shell smooth, urceolate, with regular, circular pores of equal size, of about the same breadth as the bars. Mouth with smooth peristome, about half as broad as the shell.

*Dimensions.*—Shell 0·12 long, 0·08 broad; mouth 0·04 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific; surface, and at various depths.

4. *Cyrtocalpis urna*, Stöhr.

*Cyrtocalpis urna*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 96, Taf. iii. fig. 7.

Shell smooth, urceolate, with subregular, circular pores of different sizes, gradually increasing towards the mouth, of about the same breadth as the bars. Mouth without peristome (?), about half as broad as the shell.

*Dimensions.*—Shell 0·09 long, 0·06 broad; mouth 0·035 broad.

*Habitat.*—Fossil in tertiary rocks of Sicily (Grotte).

5. *Cyrtocalpis sethopora*, n. sp. (Pl. 52, fig. 4).

Shell smooth, urceolate, very thin-walled, with large irregular roundish meshes, each of which is closed by a thin porous sieve-plate. Mouth two-thirds as broad as the shell, with a broad, emarginate, longitudinally striped peristome. (Perhaps the shell of a Tintinnoid Infusorium ?)

*Dimensions.*—Shell 0·08 long, 0·05 broad; mouth 0·03 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

6. *Cyrtocalpis compacta*, n. sp. (Pl. 52, figs. 7, 8).

Shell smooth, ovate, very thick-walled, with small, subregular, circular pores of equal size, perpendicularly perforating the wall, about half as broad as the bars. Mouth small, only one-third as broad as the compact shell. (Perhaps a reduced *Lithocampe* or *Lithomitra* ?)

*Dimensions.*—Shell 0·08 long, 0·04 broad; mouth 0·015 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

7. *Cyrtocalpis lithomitra*, n. sp. (Pl. 52, figs. 5, 6).

Shell smooth, slender, ovate, nearly cylindrical, with small subregular, circular pores, which are disposed in nine to twelve transverse rows, and obliquely ascending perforate the wall. Mouth wide, without peristome, about two-thirds as broad as the shell. (Compare *Lithomitra*, Pl. 79.)

*Dimensions.*—Shell 0·09 long, 0·045 broad; mouth 0·03 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; also fossil in Barbados.

8. *Cyrtocalpis ovulum*, n. sp.

*Cyrtocalpis obliqua*, var. *ovulum*, Haeckel, 1862, Monogr. d. Radiol., p. 286, Taf. v. fig. 3.

Shell smooth, broad, ovate, with very numerous and small regular circular pores, quincuncially disposed, twice as broad as the bars. Mouth without peristome, about half as broad as the shell.

*Dimensions.*—Shell 0·09 long, 0·047 broad; mouth 0·04 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, surface.

9. *Cyrtocalpis obliqua*, Haeckel.

*Cyrtocalpis obliqua*, Haeckel, 1862, Monogr. d. Radiol., p. 286, Taf. v. figs. 4–11.

Shell smooth, irregularly ovate, more or less oblique, variable in size and form, sometimes nearly spherical, at other times subcylindrical. Pores subregular, circular, once or twice the breadth of the bars. Mouth simple, without peristome, about half as broad as the shell.

*Dimensions.*—Shell 0·07 to 0·1 long, 0·05 to 0·08 broad; mouth 0·03 to 0·04 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, surface.

10. *Cyrtocalpis gromia*, n. sp. (Pl. 51, fig. 11).

Shell rough, ovate, very thick-walled, with subregular, circular pores of somewhat variable size. The diameter of the internal, simple, subspherical cavity is five to six times as great as the thickness of the wall. Mouth tubular, cylindrical, very narrow, only one-sixth as broad as the shell.

*Dimensions.*—Shell 0·16 long, 0·11 broad; mouth 0·02 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Genus 530. *Mitrocalpis*,[1] Haeckel, 1881, Prodromus, p. 427.

*Definition.*—Archicorida with a double ovate or ellipsoidal shell, composed of two parallel lattice-plates, which are connected by numerous beams. Apex without horn.

The genus *Mitrocalpis* and the following closely allied *Spongocyrtis* differ from the four preceding genera of Archicorida, in the complicated structure of the shell-wall, which in the former is double, in the latter spongy. The mouth is in both genera constricted, narrow, and the apex without a horn. *Mitrocalpis* has been derived probably from *Cyrtocalpis* in the same way as *Peripyramis* from *Bathropyramis*, by development of spines on the surface of the shell, which at equal distances from the latter become connected by branches, thus forming an outer envelope.

1. *Mitrocalpis palliata*, n. sp.

Shell ellipsoidal, large, one and a third times as long as broad. Inner shell very thin-walled, with irregular, polygonal pores of very variable size and form. From its nodal points there arise numerous bristle-shaped radial beams, about as long as the diameter of the mouth, which are connected at equal distances from the surface by delicate threads, forming the outer enveloping shell. The surface of the latter is smooth. The thin bars of the inner shell are twice to four times as broad as those of the outer. Mouth about one-seventh as broad as the shell, with a short tubular peristome.

*Dimensions.*—Shell 0·35 long, 0·27 broad; mouth 0·04, distance of both shells 0·037.

*Habitat.*—Central Pacific, Station 271, surface.

## Genus 531. *Spongocyrtis*,[2] Dunikowski.

*Spongocyrtis*, Dunikowski, 1882, Denkschr. d. k. Akad. d. Wiss. Wien., vol. xlv. p. 31.

*Definition.*—Archicorida with a spongy ovate shell, the wall of which is composed of irregular spongy wickerwork. Apex without horn.

The genus *Spongocyrtis* differs from most other Monocyrtida in the spongy structure of the shell, which is found in only very few other genera of Cyrtoidea, *e.g.*, in *Spongopyramis* and *Spongomelissa*. It has been derived either from the similar

[1] *Mitrocalpis* = Turban basket; μίτρα, καλπίς.

[2] *Spongocyrtis* = Spongy basket; σπόγγος, κυρτίς.

*Cyrtocalpis* by development of irregular spongy wickerwork on the surface of the simple lattice-shell; or from *Arachnocalpis* (Pl. 98, fig. 13) by loss of the peristome.

1. *Spongocyrtis montis ovis*, Dunikowski.

*Spongocyrtis montis ovis*, Dunikowski, 1882, Denkschr. d. k. Akad. d. Wiss. Wien., vol. xlv. p. 31, Taf. vi. figs. 67, 68.

Shell broad, ovate, rough, spongy, thick-walled; length to the breadth = 4 : 3. Spongy framework very dense and dark, with very small roundish pores. Mouth constricted, with a short tubular peristome, about one-third as broad as the shell.

*Dimensions.*—Shell 0·35 long, 0·26 broad; mouth 0·08 broad.

*Habitat.*—Fossil in the Alpine Lias (Schafberg bei Salzburg, Dunikowski).

2. *Spongocyrtis arachnoides*, n. sp.

Shell ellipsoidal, spiny, spongy, thin-walled; length to the breadth = 3 : 2. Spongy framework loose and delicate, with irregular polygonal meshes and arachnoidal thread-like bars. Mouth constricted, without peristome, about one-fifth as broad as the shell. (Very similar to *Arachnocalpis ellipsoides*, Pl. 98, fig. 13, but without corona around the mouth.)

*Dimensions.*—Shell 0·32 long, 0·21 broad; mouth 0·04 broad.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

Subfamily 2. ARCHICAPSIDA, Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Cyrtocalpida, with the basal mouth of the shell fenestrated (vel Monocyrtida eradiata clausa).

Genus 532. *Halicapsa*,[1] Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Archicapsida with an apical horn.

The genus *Halicapsa*, and the following closely allied *Archicapsa*, represent together the small subfamily of Archicapsida, or of those Cyrtocalpida, in which the basal mouth of the simple shell is closed by a lattice plate. This may be the original state of this family, if it is derived from the Circospyrida (*Circospyris, Dictyospyris*) by loss of the sagittal constriction and the primary ring. But it is also possible that the Archicapsida have been partly derived from the Archicorida by secondary fenestration of the open mouth. The genus *Halicapsa* may be easily confounded with the similar Ellipsid *Lithapium* (compare p. 303, Pl. 14, figs. 8–10). The skeleton of both genera may be perfectly similar, the only distinction being the structure of the central capsule, which in *Halicapsa* is that of the MONOPYLEA, in *Lithapium* that of the PERIPYLEA.

[1] *Halicapsa* = Sea-capsule; ἅλς, κάψα.

## Subgenus 1. *Calpocapsa*, Haeckel.

*Definition.*—Surface of the shell smooth or rough, but not spiny.

### 1. *Halicapsa lithapium*, n. sp. (Pl. 97, fig. 6).

Shell pear-shaped, rough, one and a half times as long as broad. Pores subregular, circular, twice as broad as the bars. Basal plate with four larger ovate cortinar pores (two larger cardinal and two smaller jugular), and with six smaller peripheral pores (fig. 6). Horn of the apex three-sided pyramidal, stout, half as long as the shell.

*Dimensions.*—Shell 0·16 long, 0·1 broad; horn 0·08 long.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 2. *Halicapsa triglochin*, n. sp. (Pl. 53, figs. 3, 4).

Shell ovate, rough, a little longer than broad. Pores regular, circular, hexagonally framed, of the same breadth as the bars. Basal plate (fig. 4) without larger pores. Horn pyramidal, stout, about half as long as the shell, with three short, horizontally divergent secondary spines at the base (possibly remnants of three original cortinar feet ?)

*Dimensions.*—Shell 0·11 long, 0·09 broad; horn 0·06 long.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 3. *Halicapsa prunoides*, n. sp.

Shell pear-shaped, tuberculate, a little longer than broad. Pores irregular, roundish, of different sizes. Basal plate with four larger and six smaller pores. Horn pyramidal, stout, about one-third as long as the shell. (May belong perhaps to the similar Prunoidea *Lithapium*, compare p. 303 and Pl. 14, figs. 8–10.)

*Dimensions.*—Shell 0·14 long, 0·12 broad; horn 0·05 long.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Echinocapsa*, Haeckel, 1881, Prodromus, p. 429.

*Definition.*—Surface of the shell spiny, covered with thorns, papillæ or larger spines.

### 4. *Halicapsa papillata*, n. sp.

Shell bottle-shaped, papillate, one and a half times as long as broad. Pores circular, much larger in the middle part than towards the poles. The elevated frames between them bear on the

nodal points large blunt conical papillæ. Basal plate without larger pores. Horn three-sided pyramidal, one-third as long as the shell, gradually passing into the slender neck of the bottle.

*Dimensions.*—Shell 0·22 long, 0·15 broad; horn 0·07 long.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

5. *Halicapsa pyriformis*, Haeckel.

*? Haliomma pyriforme*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. p. 1, pl. i. fig. 29.

Shell pear-shaped, a little longer than broad, covered with numerous short conical spines Pores subregular, circular, of nearly equal size, twice as broad as the bars. Basal plate with four crossed larger ovate pores (two larger cardinal and two smaller jugular pores). Horn stout pyramidal, scarcely one-fourth as long as the shell.

*Dimensions.*—Shell 0·16 long, 0·14 broad; horn 0·04 long.

*Habitat.*—Fossil in Barbados, living in the North Pacific (Kamtschatka)?

6. *Halicapsa hystrix*, n. sp. (Pl. 53, figs. 5, 6).

Shell pear-shaped, subspherical, a little longer than broad, with scattered stout pyramidal spines about as long as the radius of the shell. Pores subregular, circular, three times as broad as the bars. Basal plate (fig. 6) without larger pores. Horn very large, pyramidal, longer than the shell.

*Dimensions.*—Shell 0·1 long, 0·09 broad; horn 0·13 long.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Genus 533. *Archicapsa*,[1] Haeckel, 1881, Prodromus, p. 428.

*Definition.*—Archicapsida without apical horn.

The genus *Archicapsa* differs from the preceding *Halicapsa* in the absence of the apical horn, and represents the simplest form among the Monocyrtida clausa, a simple, ovate, or pear-shaped shell without any appendages. The characteristic structure of the basal lattice-plate (with three or four large cortinar pores) makes it probable that *Archicapsa* has been derived either from *Halicapsa*, by loss of the horn, or directly from *Dictyospyris*, by reduction of the sagittal ring and constriction.

1. *Archicapsa triforis*, n. sp. (Pl. 53, figs. 1, 2).

Shell pear-shaped, smooth, one and a half times as long as broad. Pores subregular, circular, of about the same breadth as the bars. Basal plate (fig. 2) with three very large pores, three times as broad as the others (one odd sternal pore and two paired cardinal pores).

*Dimensions.*—Shell 0·09 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

[1] *Archicapsa* = Primordial capsule; ἀρχίκαψα.

2. *Archicapsa quadriforis*, n. sp.

Shell ovate, rough, a little longer than broad. Pores subregular, circular, twice as broad as the bars. Basal plate with four larger ovate cortinar pores (two smaller jugular and two larger cardinal pores).

*Dimensions.*—Shell 0·12 to 0·15 long, 0·1 to 0·12 broad.

*Habitat.*—Central Pacific, Station 265 to 268, depth 2700 to 2900 fathoms.

3. *Archicapsa nonaforis*, n. sp.

Shell pear-shaped, thorny, one and a half times as long as broad. Pores regular, circular, small, hexagonally framed, twice as broad as the bars. Basal plate with nine cortinar pores (three larger alternating with three pairs of smaller pores, as in Pl. 87, fig. 2).

*Dimensions.*—Shell 0·14 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

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## Section II. DICYRTIDA, Haeckel, 1862, Monogr. d. Radiol., pp. 280, 296.

*Definition.*—Cyrtoidea dithalamia, with two-jointed shell, being divided by a transverse collar stricture into an apical joint (or cephalis) and a basal joint (or thorax).

*Synopsis of the three Families and six Subfamilies of Dicyrtida.*

| | | |
|---|---|---|
| Family LXII. Tripocyrtida. Three radial apophyses. | Mouth open, | 1. Sethopilida. |
| | Mouth closed, | 2. Sethoperida. |
| Family LXIII. Anthocyrtida. Numerous radial apophyses. | Mouth open, | 3. Sethophormida. |
| | Mouth closed, | 4. Sethophænida. |
| Family LXIV. Sethocyrtida. No radial apophyses. | Mouth open, | 5. Sethocorida. |
| | Mouth closed, | 6. Sethocapsida. |

### Family LXII. TRIPOCYRTIDA, n. fam.

*Sethopilida et Sethoperida*, Haeckel, 1881, Prodromus, pp. 431, 433.

*Definition.*—Dicyrtida triradiata. (Cyrtoidea with a two-jointed shell, divided by a transverse constriction into cephalis and thorax, and bearing three radial apophyses.)

The family Tripocyrtida, composed of the Sethopilida and Sethoperida of my Prodromus, comprises those Cyrtoidea in which the lattice-shell is two-jointed and bears three radial apophyses. The two subfamilies differ in the shape of the mouth, which in the Sethopilida is a simple wide opening, but in the Sethoperida is closed by a lattice-plate; the former are here divided into sixteen, the latter into eight different genera. Though probably the two shell-joints are not truly homologous in all Tripocyrtida, we call the first joint here, as in all Dicyrtida, the cephalis, and the second joint the thorax.

Numerous Tripocyrtida, living as well as fossil forms, were formerly described by Ehrenberg. His genera *Dictyophimus*, *Clathrocanium*, *Lithomelissa*, and *Lychnocanium* belong to the Sethopilida, and have the mouth open; his genera *Lithopera* and *Lithochytris* (partly) belong to the Sethoperida, and have the basal mouth closed by a lattice-plate. Many of these Tripocyrtida belong probably to the oldest forms of Dicyrtida, are nearly related to the Phormospyrida, and therefore of special phylogenetic interest, as was demonstrated by Bütschli (1882, *loc. cit.*, pp. 514–519). This near relation to certain Spyroidea (*Tripospyris*, *Acrospyris*, &c.) is particularly striking in some forms of *Clathrocanium*, *Lithomelissa*, &c. Some other Tripocyrtida seem to possess a closer relation to certain Plectoidea (*Plagoniscus*, *Plectaniscus*), so mainly some forms of *Tripocyrtis* and *Dictyophimus*.

The cephalis, or the first joint of the shell, corresponds usually to the whole shell of the Zygospyrida and of numerous Monocyrtida, and exhibits various modifications of shape, which have been already described in these latter families. It is usually subspherical or hemispherical and armed with an apical horn. In a small number of genera the horn is lost, in some other genera multiplied. The cephalis is separated from the thorax not only externally by the collar constriction, but commonly also internally by a transverse horizontal fenestrated septum, which usually exhibits three or four characteristic cortinar pores. The central capsule, originally enclosed in the cephalis, develops usually three or four large pear-shaped cæcal sacs which pass through the cortinar pores and depend into the thorax (Pl. 55, figs. 2–11; Pl. 60, figs. 3–7, &c.).

The thorax in this family exhibits a great variety of interesting modifications, mainly in the development of the three radial apophyses arising from it. These may be either enclosed in the wall of the thorax as ribs, or arise as free wings, very often prolonged over the mouth as three terminal feet. Finally the three terminal feet only remain, whilst the original ribs are lost. The special ornamentation of these three apophyses exhibits an extraordinary variety and elegancy of structure, and many Tripocyrtida belong, no doubt, to the most graceful and admirable forms of NASSELLARIA.

## *Synopsis of the Genera of Tripocyrtida.*

- **I. Subfamily Sethopilida. Terminal mouth of the thorax a simple wide opening.**
  - A. Three radial ribs (or cortinar rods) partly or completely enclosed in the wall of the thorax. No latticed vertical cephalic wings.
    - *a.* Three thoracic ribs prolonged into three terminal feet.
      - Cephalis with a horn.
        - Feet solid, . 534. *Dictyophimus.*
        - Feet latticed, 535. *Tripocyrtis.*
      - No horn, feet solid, . 536. *Sethopilium.*
    - *b.* Three thoracic ribs prolonged into three lateral wings.
      - Thorax perfectly latticed.
        - With horn, 537. *Lithomelissa.*
        - No horn, . 538. *Psilomelissa.*
      - Thorax with spongy framework, . . . 539. *Spongomelissa.*
      - Thorax with three large lateral holes between the three ribs, . . 540. *Clathrocanium*
    - *c.* Three thoracic ribs completely enclosed in the wall of the flat thorax.
      - Peristome simple, smooth, . 541. *Lamprodiscus*
      - Peristome with a corona of spines, . . . 542. *Lampromitra.*
  - B. Three radial ribs enclosed in the wall of the thorax and connected with the cephalic horn by three latticed vertical wings.
    - *a.* Thorax completely latticed.
      - No frontal horn (four spines), 543. *Callimitra.*
      - With frontal horn (five spines), . . . 544. *Clathromitra.*
    - *b.* Thorax with three large lateral holes between the three ribs. No frontal horn, . . 545. *Clathrocorys.*
  - C. Three radial beams (or cortinar rods) perfectly free, not enclosed in the wall of the thorax.
    - Three beams outside the thorax, arising freely from the collar stricture (no cephalic hole), 546. *Eucecryphalus.*
    - Three beams inside the thorax. Cephalis with a large apical hole, . . . 547. *Amphiplecta.*
  - D. Three radial terminal feet on the peristome (the three original lateral ribs are lost).
    - Feet solid, . . . 548. *Lychnocanium.*
    - Feet latticed, . . 549. *Lychnodictyum.*
- **II. Subfamily Sethoperida. Terminal mouth of the thorax closed by a lattice-plate.**
  - Three divergent ribs (or cortinar rods) enclosed either in the wall or in the cavity of the thorax.
    - Three ribs enclosed in the lattice-wall of the thorax, 550. *Sethopera.*
    - Three internal rods in the cavity of the thorax, . 551. *Lithopera.*
  - Three divergent free lateral wings (as prolongation of the three ribs) on the sides of the thorax.
    - Three solid lateral spines.
      - Cephalis with horn, 552. *Micromelissa.*
      - No horn, . 553. *Peromelissa.*
    - Three latticed lateral wings. With horn, . . 554. *Sethomelissa.*
  - Three free terminal feet (on the base of the thorax).
    - Three feet solid, . . 555. *Tetrahedrina.*
    - Three feet latticed.
      - Shell without external mantle, 556. *Sethochytris.*
      - Shell with an arachnoidal mantle, . 557. *Clathrolychnus.*

Subfamily 1. SETHOPILIDA, Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Tripocyrtida, with the basal mouth of the shell open (vel Dicyrtida triradiata aperta).

Genus 534. *Dictyophimus*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 53.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three complete thoracic ribs, prolonged into three solid divergent feet on the peristome. Cephalis with an apical horn.

The genus *Dictyophimus*, comprising many common species, may be regarded as the common ancestral form of all Sethopilida, and therefore also of the whole family of Dicyrtida. The cephalis bears an apical horn, and the thorax three ribs, which are prolonged over the open mouth into three solid feet. *Dictyophimus* may be derived either from *Euscenium* or *Peridium* (Archiperida), or from *Tripospyris* (Zygospyrida), or from *Plectaniscus* (Plectanida), by development of lattice-work between the three terminal feet, which therefore become thoracic ribs.

Subgenus 1. *Dictyophimium*, Haeckel.

*Definition.*—Shell smooth or rough, without prominent spines on the edges of the three thoracic ribs. (Commonly one single horn on the cephalis.)

1. *Dictyophimus sphærocephalus*, n. sp. (Pl. 57, fig. 10).

Shell smooth, with a deep collar stricture, separating two joints of nearly equal size. Cephalis subglobular, rough, with a stout pyramidal horn of half the length, and regular, circular, hexagonally framed pores. Thorax nearly three-sided prismatic, smooth, with three stout, little divergent or nearly parallel ribs, which are prolonged into conical subvertical feet half as long. Thoracic pores irregular, roundish.

*Dimensions.*—Cephalis 0·08 long, 0·08 broad; thorax 0·08 long, 0·08 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Dictyophimus tripus*, Haeckel.

*Dictyophimus tripus*, Haeckel, 1862, Monogr. d. Radiol., p. 306, Taf. vi. fig. 1.

Shell with a slight collar stricture, separating two joints of slightly different size. Cephalis nearly ellipsoidal, large, with a slender conical horn of the same length. Thorax truncate three-sided

[1] *Dictyophimus* = Net goblet; δίκτυον φιμός.

pyramidal, with three strongly divergent ribs, which are prolonged into three slender conical feet of about the same length. Pores irregular, roundish, of variable size.

*Dimensions.*—Cephalis 0·032 long, 0·028 broad; thorax 0·34 long, 0·064 broad.

*Habitat.*—Mediterranean (Messina), Atlantic (Canary Islands), surface.

### 3. *Dictyophimus plectaniscus*, n. sp. (Pl. 61, figs. 8, 9).

Shell flat, pyramidal, smooth, with distinct collar stricture. Cephalis hemispherical, with a conical horn of the same length and numerous small regular pores. Thorax flat, triangular, pyramidal, with three widely divergent ribs, which are prolonged into three cylindrical feet of the same length. Thoracic pores fifteen, very large, subregular, roundish, disposed in two transverse girdles, the inner with six, the outer with nine pores; five pores between every two ribs.

*Dimensions.*—Cephalis 0·04 long, 0·06 broad; thorax 0·08 long, 0·18 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### 4. *Dictyophimus craticula*, Ehrenberg.

*Dictyophimus craticula*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. v. figs. 4, 5.

*Dictyophimus craticula*, Bütschli, 1882, Zeitschr. f. Wiss. Zool., vol. xxxvi. p. 515, Taf. xxxiii. fig. 35.

Shell flat, pyramidal, very similar to the preceding species, but differing in the rudimentary horn, which is smaller than half the cephalis, and in the length of the three cylindrical feet, which are twice to three times as long as the shell. The nine inferior large pores of the thorax are twice to three times as large as the six superior pores. The basal peristome is commonly thorny.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·1 long, 0·2 broad.

*Habitat.*—Fossil in Barbados.

### 5. *Dictyophimus pyramis*, n. sp. (Pl. 61, fig. 16).

Shell regular, pyramidal, with flat collar stricture. Relative length of the two joints = 1 : 4, breadth = 2 : 6. Cephalis hemispherical, with a stout pyramidal horn of the same length. Thorax triangular pyramidal, with three prominent ribs, which are prolonged into three slender pyramidal feet, half as long. Pores small and very numerous, subregular, circular.

*Dimensions.*—Cephalis 0·03 long, 0·05 broad; thorax 0·1 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### 6. *Dictyophimus challengeri*, Haeckel.

*Dictyophimus challengeri*, Haeckel, 1878, Protistenreich, p. 47, fig. 35.

Shell campanulate, with sharp collar stricture. Relative length of the joints = 1 : 3, breadth = 1 : 4. Cephalis subspherical, with a stout pyramidal horn of twice the length, and numerous

very small pores. Thorax nearly hemispherical, with three vaulted bosoms between the three decurrent ribs, which are prolonged into three nearly parallel and vertical feet of about the same length. Pores subregular, circular, of medium size. This species is very similar to *Lychnodictyum challengeri*, Haeckel, but differs in the smaller straight horn and the longer solid feet, which are not fenestrated.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·09 long, 0·13 broad.

*Habitat.*—Tropical Atlantic, Station 347, surface.

### 7. *Dictyophimus lasanum*, n. sp. (Pl. 61, fig. 5).

Shell nearly pear-shaped, with distinct collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis hemispherical, with a conical horn of the same length. Thorax nearly spherical, on both poles truncate and constricted, with three decurrent curved ribs and small regular circular pores. The prolongations of the ribs form three divergent pyramidal straight feet, nearly as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·09 long, 0·09 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 8. *Dictyophimus longipes*, n. sp. (Pl. 61, fig. 3).

Shell three-sided pyramidal, with distinct collar stricture. Relative length of the two joints = 1 : 4, breadth = 2 : 6. Cephalis hemispherical, with a rudimentary pyramidal horn, scarcely one-fourth as long; and with small circular regular pores. Thorax with larger irregular pores, and three vaulted bosoms between the three decurrent ribs, which are prolonged into three very long and slender prismatic feet, S-shaped, curved, and twice to three times as long as the shell.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·09 long, 0·13 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

### 9. *Dictyophimus gracilipes*, Bailey.

*Dictyophimus gracilipes*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. p. 4, pl. i. fig. 8.

Shell three-sided pyramidal, with a deep collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis hemispherical, with a thin horn of the same length. Thorax with three curved ribs, which are prolonged into three divergent angular feet of the same length. Pores irregular roundish.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·05 long, 0·08 broad.

*Habitat.*—North Pacific, Station 240, surface, Kamtschatka (Bailey).

### 10. *Dictyophimus cortina*, n. sp. (Pl. 61, fig. 1).

Shell three-sided pyramidal, with distinct collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subspherical, with a pyramidal horn of half the length. Thorax

with much larger irregular roundish pores and three prominent ribs, which are prolonged into three stout, club-shaped, strongly divergent feet of the same length. Mouth widely open, elegantly coronate, with a circle of numerous small cilia.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 11. *Dictyophimus arabicus*, Haeckel.

*Lychnocanium arabicum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 296, Taf. x. fig. 3.

Shell smooth, three-sided pyramidal, with deep collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subspherical, with a slender horn of the same length. Thorax with much larger, irregular roundish pores, and three widely divergent ribs, which are prolonged into three slender, somewhat recurved feet of about the same length.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·07 long, 0·09 broad.

*Habitat.*—Indian Ocean, Zanzibar (Pullen), depth 2200 fathoms.

### 12. *Dictyophimus platycephalus*, n. sp. (Pl. 60, figs. 4, 5).

Shell smooth, flat, three-sided pyramidal, with distinct collar stricture. Relative length of the two joints = 1 : 3, breadth = 3 : 9. Cephalis flat, cap-shaped, three times as broad as long, with a slender conical horn of the same length. Thorax flatly vaulted, with much larger, irregular roundish, double-edged pores, and three widely divergent ribs, which are prolonged into three slender conical feet of the same length. Central capsule in the cephalis flat, discoidal, with a discoidal nucleus of half the size, and with four large pear-shaped cæcal sacs depending into the thorax, each of which contains a large oil globule (fig. 4).

*Dimensions.*—Cephalis 0·02 long, 0·07 broad; thorax 0·06 long, 0·18 broad.

*Habitat.*—North Atlantic, Canary Islands (Lanzerote), Haeckel, surface.

### 13. *Dictyophimus brandtii*, n. sp. (Pl. 60, fig. 6).

Shell smooth, flat, three-sided pyramidal, with deep collar stricture, very similar to the preceding species. Relative length of the two joints = 1 : 3, breadth = 2 : 7. Cephalis hemispherical, with a slender conical horn of twice the length. Thorax flatly vaulted, with irregular polygonal pores and thin bars; and with three widely divergent ribs, which are prolonged into three slender prismatic feet of thrice the length. In fig. 6 the shell is seen from the base and exhibits very distinctly the collar septum with its four large meshes, two minor jugular and two major cardinal pores.

*Dimensions.*—Cephalis 0·03 long, 0·07 broad; thorax 0·08 long, 0·2 broad.

*Habitat.*—North Pacific, Station 236, surface.

14. *Dictyophimus lucerna*, Haeckel.

*Lychnocanium lucerna*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 6; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 80, Taf. viii. fig. 3.
*Lychnocanium lucerna*, Haeckel, 1862, Monogr. d. Radiol., p. 311.

Shell smooth, three-sided pyramidal, with slight collar stricture. Relative length of the two joints = 1 : 4, breadth = 1 : 4. Cephalis hemispherical, with a thick conical horn of twice the length. Thorax with small regular, circular pores and three flat sides; between these arise three rounded ribs, which are prolonged into three short, conical, divergent feet, one-third as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·025 broad; thorax 0·08 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

15. *Dictyophimus hamosus*, Haeckel.

*Lychnocanium hamosum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. vii. fig. 9.

Shell pear-shaped, rough, with deep collar stricture. Relative length of the two joints = 1 : 2, breadth = 1 : 3. Cephalis subglobular, with a conical horn of twice the length. Thorax with small, regular, circular pores, and with three prominent ribs, prolonged into three vertical prismatic feet, which are about as long as the shell, parallel or a little convergent towards the distal end, with recurved teeth or hooks at the lateral edges.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

16. *Dictyophimus tridentatus*, Haeckel.

*Lychnocanium tridentatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 4.

Shell smooth, three-sided pyramidal, with deep collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subspherical, with a conical horn of the same length, and some small accessory thorns. Thorax tetrahedral, with three smooth hyaline walls, bearing only a single series of small pores on each side of the three prominent ribs, which are prolonged into three strong prismatic curved feet of twice the length, with the convexity external. A group of small pores and a strong triangular tooth at the base of each foot.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

Subgenus 2. *Lamprotripus*, Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Shell spiny or thorny, with prominent spines on the edges of the three thoracic ribs. (Commonly one larger and a few smaller horns or spines on the cephalis.)

17. *Dictyophimus triserratus*, n. sp. (Pl. 61, fig. 17).

Shell three-sided pyramidal, with slight collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis small, subspherical, with a large pyramidal horn three times as long. Thorax with much larger, irregular roundish, double-edged pores, and three prominent, serrate ribs, which are prolonged into three pyramidal strongly divergent feet of the same length.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·06 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

18. *Dictyophimus bicornis*, n. sp.

Shell thorny, with deep collar stricture. Relative length of the two joints = 2 : 3, breadth = 2 : 3. Cephalis nearly as large as the thorax, subglobular, with numerous small, circular pores, and two divergent pyramidal horns of half the length (a major occipital and a minor frontal horn). Thorax three-sided pyramidal, with larger irregular pores and three serrate ribs, which are prolonged into three prismatic spiny feet of half the length. (Differs from the similar *Dictyophimus sphærocephalus*, Pl, 57, fig. 10, mainly in the double horn and the spinulate feet.)

*Dimensions.*—Cephalis 0·05 long, 0·05 broad; thorax 0·08 long, 0·07 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

19. *Dictyophimus pocillum*, Ehrenberg.

*Dictyophimus pocillum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. v. fig. 6.

Shell thorny, with distinct collar stricture. Relative length of the two joints = 1 : 5, breadth = 1 : 5. Cephalis nearly spherical, with numerous small conical spines. Thorax flat, three-sided pyramidal with large, irregular, roundish pores, and three strong, widely divergent, spinulate ribs, which are prolonged into three prismatic spinulate feet of the same length.

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·15 long, 0·15 broad.

*Habitat.*—Fossil in Barbados.

20. *Dictyophimus cienkowskii*, n. sp. (Pl. 60, fig. 1).

*Lamprotripus squarrosus*, Haeckel, 1881, Prodromus et Atlas.

Shell spiny, flatly pyramidal, with slight collar stricture. Relative length of the two joints = 1 : 3, breadth = 2 : 6. Cephalis flat, cap-shaped, three times as long as broad, with numerous bristle-shaped spines three times as long. Thorax also spiny, with irregular, very large, polygonal meshes and thin bars; its three ribs prolonged into three very long and thin, widely divergent, prismatic feet, bearing numerous long spines on the three edges.

*Dimensions.*—Cephalis 0·025 long, 0·05 broad; thorax 0·075 long, 0·15 broad.

*Habitat.*—North Pacific, Station 250, surface.

21. *Dictyophimus bütschlii*, n. sp. (Pl. 60, fig. 2).

*Lamprotripus horridus*, Haeckel, 1881, Prodromus et Atlas.

Shell spiny, flatly pyramidal, with deep collar stricture. Relative length of the two joints = 1 : 2, breadth = 1 : 5. Cephalis subspherical, with numerous long, bristle-shaped spines and a larger ramified horn. Thorax also spiny, flatly vaulted, with large, subregular, hexagonal meshes and thin bars; its three spiny ribs prolonged into three very long and thin, prismatic, widely divergent feet, twice to four times as long as the thorax.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·08 long, 0·2 broad.

*Habitat.*—South Pacific, Station 284, surface.

22. *Dictyophimus hertwigii*, n. sp. (Pl. 60, fig. 3).

*Lamprotripus spinosus*, Haeckel, 1881, Prodromus et Atlas.

Shell spiny, flatly pyramidal, with sharp collar stricture. Relative length of the two joints = 1 : 2, breadth = 1 : 5. Cephalis subspherical, with irregular roundish pores, numerous small spines and a large, oblique, prismatic horn of the same length, bearing on its distal end a bunch of small divergent spines. Thorax pyramidal, with larger irregular polygonal pores and thin bars; its three strong, widely divergent ribs spiny, straight, and prolonged into three prismatic slender feet of the same length. Central capsule with three lobes depending into the thorax.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·08 long, 0·2 broad.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

## Genus 535. *Tripocyrtis*,[1] n. gen.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three complete thoracic ribs, prolonged into three latticed divergent feet on the peristome. Cephalis with an apical horn.

The genus *Tripocyrtis* has been derived from the preceding *Dictyophimus* by complete fenestration of the three basal feet, which throughout their whole length become united by complete lattice-work. This genus is closely allied to *Plectaniscus*.

1. *Tripocyrtis plagoniscus*, n. sp. (Pl. 60, fig. 10).

Cephalis subspherical, with large, roundish meshes and a stout, three-sided pyramidal, irregularly branched horn of twice the length. Thorax with a small number of large, irregular, polygonal meshes and three stout curved ribs about as long as the cephalic horn.

*Dimensions.*—Cephalis 0·06 long, 0·07 broad; thorax 0·11 long, 0·16 broad.

*Habitat.*—Central Pacific, Station 266, surface.

[1] *Tripocyrtis* = Basket with a tripod; τρίπους, κυρτίς.

2. *Tripocyrtis tripodiscus*, n. sp.

Cephalis subspherical, with small, polygonal pores and a large, arborescent, vertical horn of thrice the length, bearing numerous ramified branches. Thorax with three straight, widely divergent ribs, of the same length as the horn, connected by a delicate, arachnoidal framework with irregular, polygonal meshes.

*Dimensions.*—Cephalis 0·04 long, 05 broad; thorax 0·12 long, 0·18 broad.

*Habitat.*—Central Pacific, Station 269, surface.

3. *Tripocyrtis plectaniscus*, n. sp. (Pl. 60, fig. 9).

Cephalis subspherical, with small roundish pores, and a stout, three-sided pyramidal, denticulate horn of the same length. Thorax with three little divergent and curved ribs, twice as long as the horn, in the upper half with smaller, in the lower half with larger, polygonal, irregular meshes.

*Dimensions.*—Cephalis 0·05 long, 0·06 broad; thorax 0·1 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 264, surface.

## Genus 536. *Sethopilium*,[1] Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three complete thoracic ribs, which are prolonged into three solid divergent feet on the peristome. Cephalis smooth, without a horn.

The genus *Sethopilium* differs from its probable ancestral form *Dictyophimus* by the complete loss of the cephalic horn, and of the collar septum between both joints, which are only separated by the slight external collar stricture.

1. *Sethopilium orthopus*, n. sp. (Pl. 97, fig. 8).

Shell smooth, with sharp collar stricture. Relative length of the two joints = 5 : 4, breadth = 7 : 6. Cephalis large, subspherical, with numerous regular circular pores, twice as broad as the bars. Thorax with three stout, straight, widely divergent ribs, prolonged into three straight pointed feet of the same length. Between every two ribs, in the centre of the collar stricture, a single large triangular mesh, and beyond this three to six rows of smaller irregular meshes.

*Dimensions.*—Cephalis 0·05 long, 0·07 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Sethopilium cyrtopus*, n. sp.

Shell smooth, with sharp collar stricture. Relative length of the two joints = 4 : 5, breadth = 7 : 11. Cephalis hemispherical, with large irregular roundish pores, four times as broad as the bars.

[1] *Sethopilium* = Small fenestrated hat; *σήθω*, *πίλιον*.

Thorax with three stout, curved, widely divergent ribs, prolonged into three cylindro-conical, curved feet of twice the length, which are convex in the proximal half, concave in the distal half. Between every two ribs, beyond the collar stricture, two large ovate meshes, and beyond this two rows of smaller irregular meshes.

*Dimensions.*—Cephalis 0·04 long, 0·07 broad; thorax 0·05 long, 0·11 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Sethopilium macropus*, n. sp. (Pl. 97, fig. 9).

Shell smooth, with slight collar stricture. Relative length of the two joints = 4 : 7, breadth = 6 : 13. Cephalis hemispherical, with irregular double-contoured pores, about as broad as the bars. Thorax with three very stout, curved, widely divergent ribs, prolonged into three curved, cylindrical, very long feet, which are three to four times as long as the shell, and convex on the outside. Between every two ribs, beyond the collar stricture, two large broad meshes, and beyond this two or three rows of smaller meshes.

*Dimensions.*—Cephalis 0·04 long, 0·06 broad; thorax 0·07 long, 0·13 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 537. *Lithomelissa*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three free lateral wings, or solid spines arising from the sides of the thorax. No terminal feet. Cephalis with one or more horns.

The genus *Lithomelissa*, containing numerous and widely distributed forms, may like *Dictyophimus* be regarded as one of the most primitive and ancient forms of Dicyrtida. It differs from the latter by the lateral (not terminal) position of the three thoracic feet, and may be derived either from *Dictyophimus* (by secondary development of intrapedal network towards the mouth, on the inside of the three feet) or directly from *Tripospyris* by similar formation of thoracic network beyond the collar stricture, outside the base of the three divergent feet and pierced by the latter. As the species of this genus are numerous, it may perhaps be better to divide it into two or three genera: *Acromelissa*, with a single horn, *Micromelissa*, with two horns, and *Sethomelissa*, with three or more horns.

Subgenus 1. *Acromelissa*, Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Cephalis with a single occipital horn.

[1] *Lithomelissa* = Stone bee; λίθος, μέλισσα.

1. *Lithomelissa macroptera*, Ehrenberg.

*Lithomelissa macroptera*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p.78, Taf. iii. figs. 9, 10.

Shell smooth, with distinct collar stricture. Relative length of the two joints = 4 : 5, breadth = 3 : 4. Cephalis ovate, with a stout, excentric, vertical, pyramidal horn of the same length. Thorax little larger, ovate, truncate. Both joints with very small and scattered pores. Three divergent ribs arise from the base of the cephalic horn, and are prolonged over the major part of the thorax; their under free part arises from the middle part of the thorax and is as long as the horn, straight, pyramidal. Mouth truncate, little constricted.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·05 long, 0·04 broad.

*Habitat.*—Fossil in Barbados.

2. *Lithomelissa ehrenbergii*, Bütschli.

*Lithomelissa ehrenbergii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 517, Taf. xxxiii. fig. 21*a*, *b*.

*Lithomelissa macroptera*, var., Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 8.

(*?*) *Lophophæna capito*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 6.

(*?*) *Lophophæna galeata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 12.

Shell rough, with distinct collar stricture. Relative length of the two joints = 4 : 2, breadth = 3 : 4. Cephalis ovate, with a stout excentric, oblique, pyramidal horn of half the length. Thorax little shorter, truncate, conical. Both joints with regular circular pores, of the same breadth as the bars. Three divergent conical feet, as long as the cephalis, arise below the collar stricture. Mouth truncate, not constricted.

*Dimensions.*—Cephalis 0·08 long, 0·06 broad; thorax 0·04 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; fossil in Barbados.

3. *Lithomelissa macroceras*, n. sp.

Shell spiny, with sharp collar stricture. Relative length of the two joints = 5 : 7, breadth = 5 : 6. Cephalis spherical, with a large pyramidal horn of twice the length. Thorax little longer, ovate, truncate. Both joints with regular circular pores, three times as broad as the bars. Three divergent pyramidal feet, twice as long as the cephalis, arise from the middle part of the thorax. Mouth constricted, half as broad as the thorax.

*Dimensions.*—Cephalis 0·05 long, 0·05 broad; thorax 0·07 long, 0·06 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

4. *Lithomelissa mitra*, Bütschli.

*Lithomelissa mitra*, Bütschli, 1881, Zeitschr. f. wiss. Zool., p. 518, Taf. xxxiii. fig. 24.

Shell smooth, with distinct collar stricture. Relative length of the two joints = 5 : 4, breadth = 4 : 5. Cephalis ovate, with a slender, straight, vertical, pyramidal horn of the same length. Thorax ovate,

truncate, of about the same size. Both joints with very small and numerous pores, as broad as the bars. Three feet arising from the middle part of the thorax, very small, rudimentary, pyramidal, about as long as broad. Mouth truncate, little constricted.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·04 long, 0·05 broad.

*Habitat.*—Fossil in Barbados.

5. *Lithomelissa pycnoptera*, n. sp.

Shell rough, papillate, with slight collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis small, hemispherical, with very small pores and a slender, straight, conical horn of twice the length. Thorax subconical, with regular circular, hexagonally framed pores, as broad as the bars. From its lower half arise three divergent, very strong feet, pyramidal, as long as the thorax, and three times as long as broad.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·1 diameter.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

6. *Lithomelissa microstoma*, n. sp.

Shell papillate, with slight collar stricture. Relative length of the two joints = 1 : 5, breadth = 1 : 5. Cephalis small, hemispherical, with a conical horn of twice the length. Thorax subspherical, with subregular circular pores, three times as broad as the bars. From its middle part arise three divergent, stout, conical feet, of half the length, and twice as long as broad. Mouth small, strongly constricted, one-fourth to one-third as broad as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·15 diameter.

*Habitat.*—Fossil in Barbados.

7. *Lithomelissa amphora*, Stöhr.

*Lithomelissa amphora*, Stöhr, 1880, Palæontograph, vol. xxvi. p. 100, Taf. iii. fig. 11.

Shell smooth, with sharp collar stricture. Relative length of the two joints = 1 : 5, breadth = 2 : 4. Cephalis small, hemispherical, with a cervical horn of the same length. Thorax ovate, with small regular circular pores, twice as broad as the bars. From its upper half arise three divergent, slender, conical feet, only one-fourth as long. Mouth constricted, with a hyaline peristome, half as broad as the thorax.

*Dimensions.*—Cephalis 0·013 long, 0·026 broad; thorax 0·063 long, 0·053 broad.

*Habitat.*—Fossil in tertiary rocks of Sicily; Grotte (Stöhr).

Subgenus 2. *Micromelissa*, Haeckel, 1881, Prodromus, p. 433 (*sensu emendato*).

*Definition.*—Cephalis with two divergent horns, a superior occipital horn and an inferior frontal horn.

### 8. *Lithomelissa thoracites*, Haeckel.

*Lithomelissa thoracites*, Haeckel, 1862, Monogr. d. Radiol., p. 301, Taf. vi. figs. 2–8.
*Lithomelissa thoracites*, R. Hertwig, 1879, Organism. d. Radiol., p. 76, Taf. viii. fig. 1.

Shell smooth, with deep collar stricture. Cephalis ovate, with two divergent, slender, conical horns, of about half the length; a major oblique occipital horn on the posterior face, and a minor, nearly horizontal horn above the collar stricture, on the anterior face. Thorax about as large as the cephalis, truncate, ovate. Pores of both joints irregular, roundish, of different sizes. From the upper half of the thorax, below the collar stricture, there arise three slender, conical divergent feet, about as long as the cephalis. Mouth truncate, wide open, not constricted. On the numerous varieties of this common species compare my Monograph, on the structure of the ovate central capsule (enclosed in the cephalis), Hertwig, *loc. cit.*

*Dimensions.*—Cephalis 0·05 to 0·06 long, 0·04 to 0·05 broad; thorax 0·03 to 0·05 long, 0·05 to 0·07 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, surface.

### 9. *Lithomelissa mediterranea*, J. Müller.

*Lithomelissa mediterranea*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 45, Taf. vi. fig. 11.
*Lithomelissa mediterranea*, Haeckel, 1862, Monogr. d. Radiol., p. 302.

Shell smooth, with sharp collar stricture. Relative length of the two joints = 4 : 5, breadth = 4 : 5. Cephalis campanulate, conical, with two divergent small conical horns, a major occipital subvertical horn near the summit, and a minor sub-horizontal frontal horn near the collar stricture. Thorax truncate, ovate, little larger than the cephalis. From its lower part there arise three short conical, divergent feet, scarcely half as long as the cephalis (in Müller's figure one of them is seen shortened, opposite to the frontal horn). Pores irregular, roundish, much smaller in the cephalis than in the thorax. Mouth wide open, not constricted.

*Dimensions.*—Cephalis 0·04 diameter, thorax 0·05 diameter.

*Habitat.*—Mediterranean (French shore), J. Müller, surface.

### 10. *Lithomelissa bicornis*, Ehrenberg.

*Lithomelissa bicornis*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. ii. fig. 7.

Shell smooth, with deep collar stricture. Relative length of the two joints = 1 : 3, breadth = 1 : 2. Cephalis hemispherical, with two divergent, stout and straight, pyramidal horns; a larger occipital horn sub-vertical near the summit, and a smaller oblique frontal horn near the collar stricture. Thorax subspherical, twice as large, with larger irregular, roundish pores. From its lower half there arise three divergent curved pyramidal feet of about the same length. Mouth constricted, only one-third as broad as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·06 diameter.

*Habitat.*—Atlantic, Stations 348 to 353, surface.

11. *Lithomelissa haeckelii*, Bütschli.

*Lithomelissa haeckelii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 517, Taf. xxxiii. fig. 23, *a*, *b*.

Shell rough, with sharp collar stricture. Relative length of the two joints = 6 : 5, breadth = 6 : 7. Cephalis subspherical, large, with two divergent horns, a very large, oblique pyramidal occipital horn on the summit, and a very small frontal horn on the middle of the forehead. Thorax campanulate, little larger than the cephalis, with regular circular pores of twice the breadth. From the upper part of the thorax, below the collar stricture, there arise three stout, divergent, angular, semi-lunar feet, about as long as the shell. Mouth wide open, not constricted.

*Dimensions.*—Cephalis 0·06 long, 0·06 broad; thorax 0·05 long, 0·07 broad.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms; fossil in Barbados.

12. *Lithomelissa bütschlii*, n. sp. (Pl. 56, fig. 1).

Shell smooth, with slight collar stricture. Relative length of the two joints = 5 : 6, breadth = 4 : 5. Cephalis ovate, large, with two small conical horns, which are opposed nearly horizontally, in the upper part of the cephalis; an anterior frontal and a posterior occipital horn. Thorax ovate, truncate, little larger. Pores of both joints irregular, roundish, of very different sizes. From the middle part of the thorax there arise three short conical divergent feet. (In the figured specimen there were some accessory thorns; in another specimen, found afterwards, the surface was quite smooth, but the two horns and the three feet much larger, half as long as the cephalis.)

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; 0·06 long, 0·05 broad.

*Habitat.*—Central Pacific, Stations 266 to 274, depth 2350 to 2925 fathoms.

Subgenus 3. *Sethomelissa*, Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Cephalis with three, four, or more horns, a primary occipital, a secondary frontal, and one or more accessory parietal horns.

13. *Lithomelissa corythium*, Ehrenberg.

*Lithomelissa corythium*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 12.

Shell smooth, with slight collar stricture. Relative length of the two joints = 4 : 3, breadth = 4 : 5. Cephalis campanulate, with three short conical horns on the summit. Thorax flat and wide. From its upper part below the collar stricture, there arise three divergent, pyramidal feet, fenestrated at the base, about as long as the shell. Mouth wide open. (The specimen figured by Ehrenberg was an incomplete one.)

*Dimensions.*—Cephalis 0·04 in diameter, thorax 0·03 long, 0·05 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; fossil in Barbados.

14. *Lithomelissa decacantha*, n. sp. (Pl. 56, fig. 2).

*Sethomelissa decacantha*, Haeckel, 1881, Prodromus et Atlas.

Shell smooth, with deep collar stricture, and with ten prismatic spines of nearly equal size and similar form. Relative length and breadth of the two joints about equal. Cephalis ovate, in the upper half hyaline, in the lower half with few scattered pores; in the equator with four prismatic horns of the same length, which diverge upwards; three of them are placed in the same meridional planes as the three wings and the three feet of the thorax (one occipital and two parietal); the fourth (frontal) horn is opposed to the occipital. Thorax campanulate, three-edged, with three vertical prominent feet (directed downward) and three horizontal wings, arising from their knees. Mouth wide open, not constricted.

*Dimensions.*—Cephalis 0·05 diameter; thorax 0·05 long, 0·06 broad.

*Habitat.*—Equatorial Atlantic, Station 347, surface.

## Genus 538. *Psilomelissa*,[1] Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three free lateral wings, or solid spines arising from the sides of the thorax. No terminal feet. Cephalis smooth, without a horn.

The genus *Psilomelissa* has the same formation of the shell as the nearly allied preceding genus *Lithomelissa*, and may be derived from it by reduction and loss of the cephalic horn. The cephalis is quite bare.

1. *Psilomelissa galeata*, Haeckel.

*Dictyocephalus galeatus*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 289, Taf. vii. fig. 25.

Shell smooth, with sharp collar stricture. Relative length of the two joints = 5 : 3, breadth = 4 : 5. Cephalis ovate, with numerous irregular, roundish pores. Thorax truncate, conical, with a few small pores. From its upper part (below the collar stricture) there arise three thin, bristle-shaped, widely divergent wings, about as long as the cephalis. Mouth widely open.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·03 long, 0·05 broad.

*Habitat.*—Western Tropical Pacific, Stations 200 to 225, surface.

2. *Psilomelissa phalacra*, n. sp.

Shell smooth, with deep collar stricture. Relative length of the two joints = 5 : 6, breadth = 4 : 4. Cephalis ovate, hyaline, with few small pores only in the lower third. Thorax cylindrical, truncate, with small irregular, roundish pores. From its upper third there arise below the stricture three club-

[1] *Psilomelissa* = Smooth bee; ψιλός, μέλισσα.

shaped, nearly horizontally divergent wings, as long as the thorax. The cephalis and the three feet are similar to those of *Peromelissa phalacra*, (Pl. 57, fig. 11); but the cylindrical thorax with irregularly scattered pores is completely different, and exhibits a truncate, wide open mouth.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·06 long, 0·04 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

3. *Psilomelissa hertwigii*, Haeckel.

*Lithomelissa hertwigii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., p. 517, Taf. xxxiii. fig. 22, *a*, *b*.

Shell rough, with obliterated collar stricture. Length of the two joints = 4 : 4, breadth = 5 : 5. Cephalis hemispherical. Thorax little larger, cylindrical. From its upper half there arise three very strong pyramidal divergent wings, about as long as the shell. Pores of both joints very small and numerous, circular. Mouth truncate, wide open.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·04 long, 0·05 broad.

*Habitat.*—Fossil in Barbados.

4. *Psilomelissa calvata*, n. sp. (Pl. 56, fig. 3).

Shell smooth, with sharp collar stricture. Length of the two joints = 7 : 5, breadth = 5 : 6. Cephalis ovate, large, with subregular, circular, double-contoured pores. Thorax smaller, ovate, with very irregular, roundish pores of different sizes. From its upper third there arise three conical, slender, widely divergent spines or wings of the same length. (In fig. 3 the cephalis with the three wings is alone represented.)

*Dimensions.*—Cephalis 0·07 long, 0·05 broad; thorax 0·05 long, 0·06 broad.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

5. *Psilomelissa sphærocephala*, n. sp.

Shell rough, with deep collar stricture. Length of the two joints = 1 : 2, breadth = 1 : 3. Cephalis spherical. Thorax cap-shaped, flat and broad. From its upper half there arise three pyramidal wings, half as long, fenestrated at the base and nearly horizontally divergent. Mouth constricted, half as broad as the thorax.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·06 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Genus 539. *Spongomelissa*,[1] n. gen.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three free lateral wings, or solid spines arising from the sides of the thorax. No terminal feet. Cephalis with one or more horns.

[1] *Spongomelissa* = Spongy bee; σπόγγος, μέλισσα.

The genus *Spongomelissa* differs from its ancestral genus *Lithomelissa* only in the development of spongy framework in the shell-wall—a very rare production in the Cyrtoidea (compare *Peripyramis*, p. 1162, and *Spongocyrtis*, p. 1188).

1. *Spongomelissa spongiosa*, Haeckel.

*Lithomelissa spongiosa*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 519, 539, Taf. xxxiii. fig. 25, *a*, *b*, *c*.

Shell of dense spongy structure, with a deep collar stricture. The subspherical cephalis and the truncate abdomen of nearly equal size, both with irregular delicate spongy framework. Mouth wide open. Cephalis with a large vertical apical and a small oblique frontal horn. Thorax with three very stout, three-sided prismatic widely divergent lateral wings, which are covered with numerous irregularly ramified branches; the spongy framework arises by communication of the delicate branches.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad, thorax 0·04 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

## Genus 540. *Clathrocanium*,[1] Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 829.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three prominent lateral ribs on the thorax, alternating with three large holes (or thoracic gates). Cephalis with a horn.

The genus *Clathrocanium* is nearly allied to *Dictyophimus* and *Lithomelissa*, and, together with these two genera, may be regarded as surviving representatives of the oldest and most primitive forms of Dicyrtida. It differs from the latter mainly in the incomplete fenestration of the shell, three large interradial holes remaining between the three perradial thoracic ribs. It may therefore be derived either from *Euscenium* or from *Tripospyris* by the development of a terminal lattice-band between the three feet. *Clathrocanium* may be divided into two different subgenera: *Clathrocanidium*, with simple horn and smooth mouth, and *Clathrocorona*, with fenestrated horn and coronated mouth.

### Subgenus 1. *Clathrocanidium*, Haeckel.

*Definition*—Horn of the cephalis simple, not fenestrated. Peristome smooth.

[1] *Clathrocanium* = Basket of network; κλῆθρα, κάγκανον.

1. *Clathrocanium squarrosum*, Ehrenberg.

*Clathrocanium squarrosum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. vii. fig. 5.

Cephalis campanulate, with irregular roundish pores and a pyramidal horn of the same length, bearing at the apex three short branches. Length of the two joints 2 : 3, breadth = 2 : 6. Thorax with three simple, prismatic, thin ribs, which are twice as long as the cephalis, separated by large triangular holes and connected only at the distal end by a small triangular ring of delicate lattice-work. Peristome smooth, wide, as broad as the thorax.

*Dimensions.*—Cephalis 0·04, long, 0·04 broad; thorax 0·06 long, 0·12 broad.

*Habitat.*—Western Tropical Pacific (Philippine Sea), depth 3300 fathoms.

2. *Clathrocanium sphærocephalum*, n. sp. (Pl. 64, fig. 1).

Cephalis spherical, with regular circular pores and a prismatic horn of the same length, with three serrated edges. Length of the two joints = 2 : 3, breadth 2 : 4. Thorax with three broad, triangular, latticed, divergent ribs, which are separated by three large ovate holes (about as large as the cephalis), and connected at the distal end by a broad fenestrated circular ring of regular lattice-work (about six pores in its height). Peristome smooth, constricted, half as broad as the thorax.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

3. *Clathrocanium coarctatum*, Ehrenberg.

*Clathrocanium coarctatum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. vii. fig. 6.

*Lychnocanium fenestratum*, Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 767.

Cephalis spherical, thorny, with regular circular pores and a simple pyramidal horn of the same length. Length of the two joints = 2 : 3, breadth = 2 : 5. Thorax with three simple, prismatic, little prominent ribs, which are separated by three large ovate holes (twice as long as the cephalis), and connected below the prominent distal end by a narrow circular ring of delicate lattice-work. Peristome smooth, wide, little narrower than the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·06 long, 0·1 broad.

*Habitat.*—Western Tropical Pacific (Philippine Sea), depth 3300 fathoms.

4. *Clathrocanium triomma*, n. sp. (Pl. 64, fig. 3).

Cephalis spherical, thorny, with regular circular pores, and a slender prismatic horn of twice the length, bearing at its apex three short recurved branches. Length of the two joints = 2 : 4, breadth = 2 : 5. Thorax with three broad prismatic, fenestrated ribs, which are separated by three large sub-

circular holes, and below the prominent distal end by a broad, triangular, roundish ring of subregular lattice-work (with square pores). Peristome smooth, about half as broad as the thorax

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·08 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### Subgenus 2. *Clathrocorona*, Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Horn of the cephalis fenestrated. Peristome on the margin of the basal mouth with a corona of spines.

#### 5. *Clathrocanium diadema*, n. sp. (Pl. 64, fig. 2).

*Clathrocorona diadema*, Haeckel, 1881, Prodromus, p. 431.

Cephalis hemispherical, thorny, with irregular roundish pores, and a large prismatic horn of twice the length, the three edges of which are denticulate and fenestrated, each with a series of square pores. Length of the two joints = 1 : 3, breadth = 2 : 4. Thorax thorny, with three broad fenestrated divergent ribs, which are separated by three large ovate holes (twice as long as the cephalis) and have their prominent distal ends connected below by a broad circular ring of lattice-work (with irregular polygonal small meshes). Peristome wide, two-thirds as broad as the thorax, with a circular corona of small square pores and alternating prominent small teeth.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·07 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

#### 6. *Clathrocanium reginæ*, n. sp. (Pl. 64, fig. 4).

*Clathrocorona reginæ*, Haeckel, 1881, Prodromus, p. 431.

Cephalis hemispherical, with irregular roundish pores and a prismatic club-shaped horn of twice the length, the three edges of which are denticulate and fenestrated. Length of the two joints = 1 : 3, breadth = 1 : 4. Thorax thorny, with three broad triangular, fenestrated and nodulated ribs, which are separated by three large ovate holes (twice as long as the cephalis) and have their prominent distal ends connected below by a circular ring of lattice-work. Peristome constricted, as broad as the thorax, with a corona of short spines.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·08 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

### Genus 541. *Lamprodiscus*,[1] Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 831.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three divergent lateral ribs in the wall of the flat, conical, discoidal, or pyramidal thorax. Cephalis with a horn. Peristome smooth, without corona of spines.

[1] *Lamprodiscus* = Splendid disk; λαμπρός, δίσκος.

The genus *Lamprodiscus*, and the following nearly allied *Lampromitra*, differ from all preceding Sethopilida in the complete connection of the three thoracic feet by lattice-work, so that they are imbedded in the thorax-wall as prominent ribs and are not prolonged beyond the margin as free feet. The shell is commonly very flat, conical or pyramidal, sometimes nearly discoidal. The margin of *Lamprodiscus* is simple, smooth.

1. *Lamprodiscus monoceros*, Ehrenberg.

*Lamprodiscus monoceros*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 295, Taf. vii. fig 2.

Shell smooth, with deep collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 8 Cephalis spherical, hyaline, without pores, with an oblique conical horn of the same length. Thorax flat, campanulate, nearly hemispherical, with convex lateral outlines, and regular hexagonal meshes, increasing gradually in size towards the mouth. Bars very thin. Peristome smooth.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·1 long, 0·16 broad.

*Habitat.*—Western Tropical Pacific (Philippine Sea), Station 200, surface.

2. *Lamprodiscus coscinodiscus*, Ehrenberg.

*Lamprodiscus coscinodiscus*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 295, Taf. vii. fig. 3.

Shell smooth, with sharp collar stricture. Thorax of the same form and structure as in the preceding species, differing from it mainly in the structure of the smooth circular margin, which is composed of a ring of very small square pores. Length of the two joints = 1 : 4, breadth = 1 : 8. Cephalis with small hexagonal pores, without horn or with a short rudimentary horn. Lateral outlines of the campanulate thorax in the upper part concave, in the lower convex.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·08 long, 0·16 broad.

*Habitat.*—Tropical Pacific, Stations 206, 224, 266, &c., surface.

3. *Lamprodiscus tricostatus*, n. sp.

Shell smooth, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 7. Cephalis spherical, with an oblique conical horn of twice the length and small circular pores. Thorax flatly, conical, twice as broad as high, with straight lateral outline, and regular hexagonal meshes, increasing gradually in size towards the mouth; bars very thin. Peristome or margin of the basal mouth circular, smooth. Very similar to *Theopilium tricostatum* (Pl. 70, fig. 6), but without abdomen. Differs from the two preceding species mainly in the conical form of the thorax and the less delicate network.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·1 long, 0·2 broad.

*Habitat.*—Cosmopolitan, Mediterranean, Atlantic, Indian Pacific; surface.

4. *Lamprodiscus lævis*, Haeckel.

*Eucecryphalus lævis*, R. Hertwig, 1879, Organism. d. Radiol., p. 77, Taf. viii. figs. 6, 6*a*, 6*b*.

Shell smooth, with distinct collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 6. Cephalis subspherical, with small circular pores and an oblique conical horn of twice the length. Thorax flat, pyramidal, twice as broad as long, with three strong, straight divergent edges and subregular roundish pores. Peristome smooth.

*Dimensions.*—Cephalis 0·025 diameter; thorax 0·08 long, 0·16 broad.

*Habitat.*—Mediterranean (Messina), R. Hertwig, surface.

## Genus 542. *Lampromitra*, Haeckel,[1] 1881, Prodromus, p. 431.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three divergent lateral ribs in the wall of the flat conical or pyramidal thorax. Cephalis commonly with a horn. Peristome with a corona of spines.

The genus *Lampromitra* differs from the preceding and nearly allied *Lamprodiscus* only in the development of a dentated peristome, or an elegant corona of teeth around the wide open mouth. It bears therefore to the latter the same relation that *Clathrocorona* does to *Clathrocanium*.

1. *Lampromitra coronata*, n. sp. (Pl. 60, fig. 7, 7*a*).

Shell flat, conical, with slight collar stricture. Length of the two joints = 1 : 2, breadth = 2 : 7. Cephalis hemispherical, with a conical oblique horn of twice the length, and small subregular hexagonal pores. Thorax with larger, subregular, hexagonal meshes, six to eight times as broad as the bars. Peristome or basal margin of the thorax circular, with a marginal ring of smaller polygonal meshes and a triple coronal of short spines; two external rings of short conical centrifugal spines, and an internal ring of thin centripetal rods (fig. 7*a*). In fig. 7 the shell is seen from below and exhibits very distinctly the internal cross of the collar septum, composed of the four divergent cortinar bars; between the latter descend the four pear-shaped lobes of the central capsule (each containing an oil globule), whilst the apical part of the capsule (with the nucleus) is hidden in the large cap-shaped cephalis.

*Dimensions.*—Cephalis 0·03 long, 0·07 broad; thorax 0·06 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Lampromitra quadricuspis* (Pl. 58, fig. 7).

Shell flat, conical, with sharp collar stricture. Length of the two joints = 1 : 3, breadth = 2 : 10. Cephalis hemispherical, with subregular circular pores and an oblique, conical, occipital horn of twice

[1] *Lampromitra* = Splendid turban; λαμπρός, μίτρα.

the length, bearing three divergent lateral branches, which are directed upwards, and correspond to the three thoracic ribs. Further down, near the collar stricture, a short divergent frontal horn arises. Thorax with irregular roundish pores of different sizes, three to six times as broad as the bars. Peristome with a simple coronal of short, conical, divergent spines, about as long as the diameter of the cephalis.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·06 long, 0·2 broad.

*Habitat.*—North Atlantic, Canary Islands, surface.

### 3. *Lampromitra furcata*, n. sp. (Pl. 58, fig. 8).

Shell flat, conical, with deep collar stricture, very similar in form and structure to the preceding species; differs from it in the shape of the peristome and the armature of the cephalis, which bears a conical, forked, occipital horn of the same length, and a small rudimentary divergent frontal horn. Length of the two joints = 1 : 2, breadth = 1 : 6. The four pores of the collar septum (two larger cardinal and two smaller jugular) exhibit in this species a peculiar asymmetry (fig. 8). The peristome bears a simple coronal of spines as long as the diameter of the cephalis. The major part of them is forked, some irregularly branched.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·06 long, 0·18 broad.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

### 4. *Lampromitra pyramidalis*, n. sp.

Shell flat, pyramidal, smooth, with slight collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 9. Cephalis subspherical, with an oblique pyramidal horn of twice the length, and small circular pores. Thorax with three strong, divergent, straight ribs and three flat triangular sides between them, with subregular hexagonal pores, increasing in size towards the mouth. Peristome with a simple coronal of large and numerous divergent, conical spines, half as long as the shell.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·09 long, 0·18 broad.

*Habitat.*—South Atlantic, Station 325, depth 2650 fathoms.

### 5. *Lampromitra huxleyi*, Haeckel (Pl. 59, fig. 1).

*Eucecryphalus huxleyi*, Haeckel, 1879, Natürl. Schöpfungsgesch., Edit. vii. Taf. xvi. fig. 9.

Shell flat, conical, spiny, with slight collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 8. Cephalis hemispherical, with a short conical horn of the same length. Thorax with irregular polygonal pores. Peristome with three coronals of divergent bristle-shaped spines; the first directed obliquely upwards, the second outwards, and the third nearly vertically, downwards; the bristles of the latter are much longer, about as long as the height of the shell.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·06 long, 0·16 broad.

*Habitat.*—Australia (east coast), Station 169, surface.

6. *Lampromitra schultzei*, Haeckel.

*Eucecryphalus schultzei*, Haeckel, 1862, Monogr. d. Radiol., p. 309, Taf. v. figs. 16–19.

Shell flat, conical, smooth, with slight collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 8. Cephalis hemispherical, with a small conical horn of half the length, and very small roundish pores. Thorax with three strong, straight ribs and irregular polygonal pores, which are much larger in the middle part than in the upper or lower part. Peristome with a double coronal of short, conical, divergent spines; the superior obliquely ascending, the inferior vertically descending. (Named in honour of the late Professor Max Schultze, the illustrious histologist.)

*Dimensions.*—Cephalis 0·025 diameter; thorax 0·07 long, 0·2 broad.

*Habitat.*—Mediterranean, Messina, surface.

7. *Lampromitra arborescens*, n. sp, (Pl. 60, fig. 8, 8*a*).

Shell flat, pyramidal, spiny, with sharp collar stricture. Length of the two joints = 1 : 3, breadth = 2 : 10. Cephalis cap-shaped, with an oblique, slender, conical horn of twice the length, and small circular pores. Thorax with three slight almost obliterated ribs and three vaulted sides between them, with irregular roundish pores. The three ribs are distinct in the proximal, not in the distal part. Peristome with a double coronal of smaller squarish pores and numerous divergent spines; the larger spines are irregularly branched and as long as the diameter of the cephalis.

*Dimensions.*—Cephalis 0·15 long, 0·03 broad; thorax 0·04 long, 0·2 broad.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

8. *Lampromitra dendrocorona*, n. sp. (Pl. 58, fig. 9).

Shell flat, conical, with smooth surface and deep collar stricture. Length of the two joints = 1 : 4, breadth = 2 : 10. Cephalis hemispherical, with a slender occipital horn of three times the length, and a small divergent frontal horn. Thorax with three strong, prominent, straight ribs and irregular polygonal meshes, increasing in size towards the mouth. Peristome with a dense coronal of numerous short conical spines and twenty-four to thirty larger arborescent spines, longer than the diameter of the cephalis.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·08 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 543. *Callimitra*,[1] Haeckel, Prodromus, 1881, p. 431.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three vertical latticed wings, which stretch between the three divergent lateral ribs of the thorax and the vertical horn of the cephalis. No frontal horn.

[1] *Callimitra* = Beautiful turban; κάλλις, μίτρα.

The genus *Callimitra*, and the two following nearly allied genera, *Clathromitra* and *Clathrocorys*, form together a peculiar small group, the Callimitrida, living in the Central Pacific, and differing from the other Sethopilida in some remarkable points, derived perhaps directly from the Archiscenida, *Archiscenium* and *Pteroscenium*, by the development of thoracic network between the three cortinar feet. In the centre of the collar septum, where these feet are united, there arises a vertical free columella, prolonged over the top of the cephalis as a free horn, and this horn is connected with the three thoracic ribs by three vertical fenestrated wings.

1. *Callimitra carolotæ*, n. sp. (Pl. 63, figs. 1, 7, 8).

Cephalis campanulate, conical, with irregular, polygonal pores, and a thin bristle-shaped apical horn of the same length. Length of the two joints = 3 : 6, breadth = 2 : 6. Thorax in the upper half with irregular network, in the lower half with parallel transverse bars; in each of its three sides descend two convergent pairs of stronger, parallel, curved ribs, not confluent at the peristome. Each of the three vertical wings with eight stronger ribs, three arising from the cephalis, five from each foot. Dedicated to my dear mother Charlotte Sethe.

*Dimensions.*—Cephalis 0·07 long, 0·05 broad; thorax 0·15 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

2. *Callimitra annæ*, n. sp. (Pl. 63, fig. 2).

Cephalis campanulate, conical, with irregular, polygonal pores, and a thin bristle-shaped horn of the same length. Length of the two joints = 1 : 2, breadth = 1 : 3. Thorax nearly in its whole extent with parallel transverse bars, which are crossed by two convergent systems of parallel beams; in each of its three sides descend four convergent pairs of stronger, parallel, curved ribs, not confluent at the peristome. Each of the three vertical wings with six stronger ribs, three arising from the cephalis, three from each foot. Dedicated to my dear first wife Anna Sethe.

*Dimensions.*—Cephalis 0·05 long, 0·05 broad; thorax 0·12 long, 0·18 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Callimitra agnesæ*, n. sp. (Pl. 63, fig. 5).

Cephalis pear-shaped, with irregular, square pores, and a slender bristle-shaped horn twice as long. Length of the two joints = 1 : 3, breadth = 1 : 5. Thorax in its whole extent with parallel transverse bars, which are crossed by two converging and crossed systems of parallel beams; in each of its three sides descend five convergent pairs of stronger, parallel, curved ribs, the two or three upper of which are crossed at the peristome. Each of the three vertical wings with five stronger ribs, three arising from the cephalis and the horn, two from each foot. Dedicated to my dear second wife Agnes Huschke.

*Dimensions.*—Cephalis 0·05 long, 0·05 broad; thorax 0·15 long, 0·22 broad.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

4. *Callimitra elisabethæ*, n. sp. (Pl. 63, fig. 6).

Cephalis nearly hemispherical, with irregular, square pores, and a strong prismatic horn thrice the length. Length of the two joints = 2 : 7, breadth = 2 : 9. Thorax in the upper third with irregular network, in the lower two-thirds with parallel transverse bars, which are crossed by two convergent systems of parallel beams; in each of its three sides descend three convergent pairs of stronger, parallel, curved ribs; the two ribs of the uppermost pair are united and confluent in a single odd rib in the lower half of the thorax. Each of the three vertical wings with seven stronger ribs, three arising from the cephalis and the horn, four from each foot. Dedicated to my dear elder daughter Elizabeth Haeckel.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·15 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

5. *Callimitra emmæ*, n. sp. (Pl. 63, figs. 3, 4).

Cephalis campanulate, with irregular, polygonal pores, and very thin bars (of the same shape as in the thorax) and with a thin bristle-shaped horn twice the length. Length of the three joints = 3 : 6, breadth = 2 : 9. Thorax in its whole extent with an arachnoidal network, similar to that in the cephalis and the three wings, composed of very numerous parallel threads, which are crossed by two crossed diagonal systems of parallel threads. In each of the three sides of the thorax descend five convergent pairs of stronger ribs, the three upper of which are crossed and form large rhomboidal meshes. Each of the three vertical wings with ten stronger ribs, four arising from the cephalis and each horn, six from each foot. Dedicated to my dear younger daughter Emma Haeckel.

*Dimensions.*—Cephalis 0·07 long, 0·06 broad; thorax 0·15 long, 0·22 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

## Genus 544. *Clathromitra*,[1] Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three vertical latticed wings, which stretch between the three divergent lateral ribs of the thorax and the vertical horn of the cephalis. The front of the latter is armed with a large frontal horn.

The genus *Clathromitra* differs from the preceding similar *Callimitra* in the development of a free frontal or sternal horn, a prolongation of an internal obliquely ascending rod, opposite to the caudal foot. Therefore the shell in this genus possesses five divergent free spines, two cephalic horns, and three thoracic feet. The lattice-work of the three vertical wings is not so delicate as in *Callimitra*.

[1] *Clathromitra* = Lattice-turban; κλῆθρα, μίτρα.

1. *Clathromitra pterophormis*, n. sp. (Pl. 57, fig. 8).

Cephalis very large, hemispherical, about as long and half as broad as the three-sided pyramidal thorax; both with irregular, polygonal meshes. Apical horn three to four times as long as the frontal horn and the three basal feet. All five spines three-sided prismatic, with nearly smooth edges. Three lateral wings half as broad as the cephalis.

*Dimensions.*—Cephalis 0·05 long, 0·1 broad; thorax 0·05 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Clathromitra pentacantha*, n. sp.

Cephalis large, hemispherical, half as long as the three-sided pyramidal thorax; both with irregular, roundish meshes. Apical horn of about the same length as the frontal horn, and twice as long as the three basal feet, All five spines three-sided prismatic, with denticulated edges. Three lateral wings about as broad as the cephalis.

*Dimensions.*—Cephalis 0·04 long, 0·08 broad; thorax 0·1 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

Genus 545. *Clathrocorys*,[1] Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three prominent lateral ribs on the thorax, alternating with three large holes (or thoracic gates). The three ribs are connected with the central apical horn of the cephalis by three vertical latticed wings.

The genus *Clathrocorys* differs from the two preceding nearly allied genera in the incomplete fenestration of the thorax, the three perradial ribs of which are separated by three large interradial holes. It has therefore the same relation to *Callimitra* that *Clathrocanium* bears to *Dictyophimus*.

1. *Clathrocorys murrayi*, n. sp. (Pl. 64, fig. 8).

Cephalis pear-shaped, with irregularly square pores. From the centre of its base there arise four strong, prismatic, radial beams of nearly equal size, the vertical, straight, cephalic horn being little longer than the three divergent, somewhat curved feet. In the three meridional planes (between the horn and each foot) a few rather thick branches arise, which by communication of the ramules form the three vertical latticed wings; each wing with two large meshes, three to five meshes of medium size, and three to four parallel arachnoidal rows of small, square, distal meshes. The three walls of the flat pyramidal thorax (between every two feet) are formed in the upper part by squarish network

[1] *Clathrocorys*=Lattice-helmet; κλῆθρα, κόρυς.

similar to that of the cephalis, in the middle part by a single row of arches separated by thin threads, and in the lower part by a narrow band of arachnoidal network. Dedicated to Dr. John Murray.

*Dimensions.*—Cephalis 0·05 long, 0·05 broad; thorax 0·0·04 long, 0·15 broad; apical distance of every two feet 0·15, of each foot and the horn 0·17.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Clathrocorys teuscheri*, n. sp. (Pl. 64, fig. 10).

Cephalis pear-shaped, with irregular, square pores. From the centre of its base there arise seven prismatic, radial beams of equal strength, supporting the lattice-work of the wall; the single vertical beam is prolonged into the apical horn; six others lie in the three meridian planes (between the horn and each foot); three ascending end in the wall of the cephalis, three descending are prolonged into the three strong feet, which are longer than the horn. In each meridional plane there arise four thicker and several thinner bars, which by communication of their ramules form the three latticed wings; each wing with a single very large mesh, two meshes of medium size, and a narrow marginal band of small, square pores. The three walls of the flat pyramidal thorax are formed in the upper part by squarish network similar to that of the cephalis, in the lower part by a narrow band of the same; between them a large hole. Dedicated to Dr. Reinhold Teuscher.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·06 long, 0·15 broad; apical distance of every two feet 0·2, of each foot and the horn 0·2.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Clathrocorys giltschii*, n. sp. (Pl. 64, fig. 9).

Cephalis pear-shaped, with irregular, polygonal pores. From the centre of its base there arise seven prismatic, radial beams of different strength; the single vertical beam bears six lateral branches (parallel to the three ascending supporting beams), and is prolonged into the apical horn; six others lie in the three meridional planes (between the horn and each foot); three weaker ascending beams end in the wall of the cephalis, three stronger descending are prolonged into the three large diverging feet, which are twice as long as the cephalic horn. The network of the three wings and of the three-sided pyramidal thorax is about the same as in the preceding species, but much more developed; the marginal bands with the squarish network are much broader, and an arachnoidal wicker-work of very thin thread-like bars fills out the large meshes. Dedicated to Mr. Adolf Giltsch.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·12 long, 0·2 broad; apical distance of every two feet 0·24, of each foot and the horn 0·2.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

## Genus 546. *Eucecryphalus*,[1] Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 836.

*Definition.*—S e t h o p i l i d a (vel Dicyrtida triradiata aperta) with three free collar

[1] *Eucecryphalus*=Nice net-cap; εὖ, κεκρύφαλος.

wings or solid spines arising from the collar stricture, and freely prominent between the horned cephalis and the flat conical thorax.

The genus *Eucecryphalus*, according to the restricted definition here given, comprises only those Sethopilida in which the three primary cortinar beams are perfectly free divergent collar wings, *i.e.*, free spines arising outside the shell from the collar stricture, between the cephalis and thorax. The type of this genus (which I formerly united with other Sethopilida) remains *Eucecryphalus gegenbauri*.

Subgenus 1. *Eucyrtomphalus*, Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Peristome or margin of the basal mouth of the thorax smooth, without marginal spines.

1. *Eucecryphalus corocalyptra*, n. sp.

Shell flatly conical, with slight collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 6. Cephalis subspherical, with an oblique conical horn twice its length. Thorax conical, twice as broad as long, with regular hexagonal meshes and straight lateral outlines. From the collar stricture there arise three slender conical spines, about as long as the thorax, divergent downwards. Similar to *Corocalyptra agnesæ* (Pl. 59, fig. 3), but without lumbar stricture and abdomen. Peristome or basal margin of the mouth of the thorax smooth, simple.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·09 long, 0·18 broad.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, surface.

2. *Eucecryphalus halicalyptra*, n. sp.

Shell flat, campanulate, with distinct collar stricture. Length of the two joints = 1 : 4, breadth = 2 : 10. Cephalis hemispherical, with two divergent conical horns, a major occipital and a minor frontal horn. Thorax with subregular hexagonal meshes and concavo-convex lateral outlines, campanulate. From the collar stricture there arise three divergent bristle-shaped spines, nearly horizontal, about half as long as the thorax. Peristome smooth, with a marginal coronal of small square pores.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·08 long, 0·2 broad.

*Habitat.*—Central Pacific, Stations 266 to 274, surface.

Subgenus 2. *Eucecryphalium*, Haeckel.

*Definition.*—Peristome or margin of the basal mouth of the thorax dentate, with a coronal of marginal spines.

### 3. *Eucecryphalus cuvieri*, n. sp.

Shell flatly conical, with slight collar stricture. Length of the two joints = 1 : 8, breadth = 2 : 10. Cephalis hemispherical, with an oblique pyramidal horn twice as long. Thorax with straight outlines and regular hexagonal meshes, increasing in size towards the mouth. From the collar stricture there arise three stout conical spines, half as long as the thorax, and diverging downwards. Peristome with a ring of small square pores and alternate conical divergent spines. Differs from the similar *Clathrocyclas alcmenæ* (Pl. 59, fig. 6), mainly in the simple apical horn and the possession of the three collar fundamental spines.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·15 long, 0·2 broad.

*Habitat.*—Tropical Atlantic, Station 342, depth 1445 fathoms.

### 4. *Eucecryphalus mülleri*, n. sp.

Shell flatly campanulate, of nearly the same structure as and similar form to that of the preceding species. Differs from it mainly in the considerable size of the cephalic horn and the three collar spines, which are bristle-shaped and longer than the shell. Length of the two joints = 1 : 4, breadth = 2 : 8. The peristome bears a double marginal ring of divergent conical spines, the upper being directed upwards, the lower downwards.

*Dimensions*—Cephalis 0·02 long, 0·04 broad; thorax 0·08 long, 0·16 broad.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

### 5. *Eucecryphalus gegenbauri*, Haeckel.

*Eucecryphalus gegenbauri*, Haeckel, 1862, Monogr. d. Radiol., p. 308, Taf. v. figs. 12–15.
*Eucecryphalus gegenbauri*, R. Hertwig, 1879, Organism. d. Radiol., p. 76, Taf. viii. figs. 5, 5*a*, 5*b*.

Shell flatly conical, campanulate, with slight collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 8. Cephalis hemispherical, with a conical horn of the same length, and very small pores. Thorax about twice as broad as high, with large, subregular, hexagonal meshes, increasing in size downwards. In the upper half of the thorax the meshes are filled up by an extremely delicate arachnoidal network. From the collar stricture there arise three divergent bristle-shaped spines half as long as the thorax. Peristome with a double coronal of small square pores (the inner smaller and more numerous than the outer), and with a single coronal of divergent marginal spines. This cosmopolitan species is rather variable.

*Dimensions.*—Cephalis 0·02 to 0·03 diameter; thorax 0·1 to 0·12 long, 0·02 to 0·25 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, surface.

6. *Eucecryphalus campanella*, Haeckel.

*Pterocodon campanella*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xix. fig. 2.

Shell campanulate, conical, with sharp collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 2. Cephalis hemispherical, with a short conical horn half as long, and very small pores. Thorax campanulate, as broad as high, with large roundish meshes, increasing in size downwards. From the collar stricture arise three strong, divergent, somewhat curved spines, nearly as long as the thorax. Peristome with a coronal of ten to twelve strong, conical, marginal spines, which are nearly parallel, directed downwards, a little curved, and half as long as the thorax. In the complete specimen examined by me, the apical horn, the three lateral wings and twelve terminal feet were well preserved.

*Dimensions.*—Cephalis 0·02 to 0·03 diameter; thorax 0·06 to 0·07 long and broad.

*Habitat.*—Fossil in Barbados.

## Genus 547. *Amphiplecta*,[1] Haeckel, 1881, Prodromus, p. 424.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta) with three internal thoracic ribs, enveloped by the network of the thorax. Cephalis with a large apical opening, surrounded by a coronal of spines.

The genus *Amphiplecta* (or *Amphicryphalus*) comprises some very peculiar forms of Sethopilida, probably widely remote from the other genera of this subfamily, and derived directly from the Plectanida (compare above, p. 921). The cortinar tripodium, composed of three feet divergent downwards, and one apical horn ascending upwards (in some species also a second frontal horn) is here enclosed in the cavity of a two-jointed shell, which exhibits two large openings, a smaller apical hole in the top of the cephalis, and a larger terminal mouth on the thorax. There is no trace of a sagittal ring.

1. *Amphiplecta amphistoma*, n. sp.

Cephalis subspherical, spiny, with sharp collar stricture on the base; its apical opening central, surrounded by a coronal of twelve to eighteen short spines. Length of the two joints = 7 : 8, breadth = 6 : 20. Thorax flatly conical, armed with bristle-shaped spines. Meshes of the network in both joints subregular, hexagonal, six to eight times as broad as the bars. Basal mouth bristly.

*Dimensions.*—Cephalis 0·07 long, 0·06 broad; thorax 0·08 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 274, surface.

2. *Amphiplecta acrostoma*, n. sp. (Pl. 97, fig. 10).

Cephalis subspherical, spiny, with distinct collar stricture on the base, its apical opening central, surrounded by a coronal of six to nine divergent denticulate spines. Length of the two joints = 5 : 6,

[1] *Amphiplecta* = Shell at both poles open, with framework around; ἀμφίπληκτα.

breadth = 4 : 15. Thorax flatly conical, armed with denticulate spines. Meshes of both joints irregular, polygonal, twice to six times as broad as the bars. Basal mouth armed with longer, divergent, denticulate spines,

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·06 long, 0·15 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

3. *Amphiplecta callistoma*, n. sp. (Pl. 59, fig. 2).

Cephalis flat, cap-shaped, spiny, with obliterated collar stricture on the base; its apical opening excentric, oblique, surrounded by a coronal of ten to twenty bristle-shaped spines. Length of the two joints = 4 : 5, breadth = 7 : 25. Thorax flatly conical, armed with long bristle-shaped spines. Meshes of both joints irregular, hexagonal, twice to six times as broad as the bars. Basal mouth with a double irregular coronal of small square pores, and of bristle-shaped divergent spines.

*Dimensions*—Cephalis 0·04 long, 0·07 broad; thorax 0·05 long, 0·25 broad.

*Habitat.*—Central Pacific, Station 271, surface.

Genus 548. *Lychnocanium*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta), with three solid terminal feet on the peristome. No thoracic ribs. Cephalis with a horn.

The genus *Lychnocanium*, very rich in common living and fossil forms, comprises those Sethopilida in which the thorax bears three simple terminal feet around the mouth, but no lateral ribs in its wall. It has therefore been probably derived from *Dictyophimus* by reduction and loss of these three lateral ribs. The mouth is commonly more or less constricted. The three feet surrounding it are sometimes divergent, straight or curved, at other times parallel and vertical, straight, or curved and convergent. The central capsule exhibited in some living species three or four distinct lobes, filling up the upper half of the thorax.

Subgenus 1. *Lychnocanella*, Haeckel.

*Definition.*—Feet divergent, straight or scarcely curved; their terminal distance greater than their basal distance.

1. *Lychnocanium lanterna*, n. sp. (Pl. 61, fig. 7).

Shell conical, rough, with slight collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis with a stout pyramidal horn of the same length. Thorax pear-shaped, twice as

[1] *Lychnocanium* = Lantern-basket; λύχνος, κάνεον.

broad as the constricted mouth, with regular, circular pores of the same breadth as the bars. Three feet pyramidal, little divergent, straight, about as long as the cephalis.

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 263 to 268, depth 2650 to 2900 fathoms.

2. *Lychnocanium continuum*, Ehrenberg.

*Lychnocanium continuum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. vii. fig. 11.

Shell smooth, with distinct collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis subspherical with a conical horn of the same length. Thorax pear-shaped, twice as broad as the constricted mouth, nearly hyaline, with a very small number of scattered minute pores. Three feet pyramidal, little divergent, straight, about as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·06 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

3. *Lychnocanium pyriforme*, n. sp. (Pl. 61, fig. 11).

Shell pear-shaped, rough, with sharp collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 5. Cephalis hemispherical, with a conical horn of the same length. Thorax inflated, four times as broad as the constricted tubular mouth, with regular, circular pores. Three feet pyramidal, straight, divergent, about as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·12 long, 0·15 broad.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, many Stations; also fossil in Barbados.

4. *Lychnocanium favosum*, n. sp. (Pl. 61, fig. 6).

Shell campanulate, rough, with slight collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 6. Cephalis hemispherical, with a rudimentary pyramidal horn of half the length. Thorax subglobular, three times as broad as the constricted mouth, with regular, circular pores, and an elevated hexagonal framework between them. Three feet cylindrical, slender, straight, divergent, twice to three times as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·025 broad; thorax 0·1 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

5. *Lychnocanium nodosum*, n. sp. (Pl. 61, fig. 14).

Shell campanulate, nodose, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subglobular, with a rudimentary conical horn of half the length. Thorax nearly hemispherical, twice as broad as the flat mouth, with regular, circular pores, and a variable

number of scattered, conical, fenestrated protuberances. Three feet very large, prismatic, straight, divergent, twice as long as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·09 long, 0·12 broad.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

### 6. *Lychnocanium carinatum*, Ehrenberg.

*Lychnocanium carinatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 5.

Shell campanulate, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis subglobular, with a slender horn of the same length. Thorax conical, twice as broad as the flat mouth, with fifteen to twenty prominent, longitudinal, divergent ribs, alternating with the same number of rows of pores. Three feet slender, prismatic, straight, divergent, twice as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·06 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

### 7. *Lychnocanium ventricosum*, Ehrenberg.

*Lychnocanium ventricosum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 12.

Shell pear-shaped, rough, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subglobular, with a stout conical horn twice the length. Thorax conical, three times as broad as the constricted mouth, with irregular, roundish pores of different sizes. Three feet stout, conical, divergent, half as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·07 long, 0·09 broad.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms; fossil in Barbados.

### 8. *Lychnocanium tribulus*, Ehrenberg.

*Lychnocanium tribulus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 1.

Shell pear-shaped, nodose, with distinct collar stricture. Length of the two joints = 1 : 4 breadth = 1 : 4. Cephalis subglobular, with a conical horn twice the length. Thorax ovate, twice as broad as the constricted mouth, with irregular, roundish pores of different sizes. Three stout feet strongly divergent, pyramidal, about as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; 0·08 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Lychnocanissa*, Haeckel.

*Definition.*—Feet divergent, more or less curved; their terminal distance greater than their basal distance.

9. *Lychnocanium fortipes*, n. sp. (Pl. 61, fig. 12).

Shell inflated, rough, with distinct collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 6. Cephalis small, hemispherical, with a pyramidal horn of half the length. Thorax subglobular, truncate, twice as broad as the constricted mouth, with large, regular, circular pores and very thin bars. Three feet very stout, prismatic, twice as long as the thorax, widely divergent, curved with convexity outwards, club-shaped at the distal end, with denticulate edges.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·1 long, 0·12 broad.

*Habitat.*—Equatorial Atlantic, Station 347, depth 2250 fathoms.

10. *Lychnocanium falciferum*, Ehrenberg.

*Lychnocanium falciferum*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 7; Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 4.
*Lithomelissa falcifera*, Haeckel, 1862, Monogr. d. Radiol., p. 303.

Shell inflated, rough, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis small, with a conical horn of half the length. Thorax subglobular, truncate, three times as broad as the constricted mouth, with small, regular, circular pores. Three feet widely divergent, twice as long as the thorax, curved like a crescent, with strong convexity outwards.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·06 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

11. *Lychnocanium tuberosum*, n. sp. (Pl. 61, fig. 13).

Shell conical, tuberculate, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subglobular, with a conical horn of the same length. Thorax inflated, twice as broad as the flat mouth, with small, irregular, roundish pores and scattered fenestrated tubercles. Three feet very large, angular, three times as long as the thorax, curved like a crescent, with strong convexity outwards.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·08 long, 0·12 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

12. *Lychnocanium hirundo*, Ehrenberg.

*Lychnocanium hirundo*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 8.
*Lithornithium hirundo*, Ehrenberg, 1854, Mikrogeol., Taf. xix. fig. 53.
*Lithocampe hirundo*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 65.

Shell conical, tuberculate, with slight collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis hemispherical, with a conical horn of half the length. Thorax cam-

panulate, twice as broad as the flat mouth, with longitudinal, divergent ribs, alternating with rows of small circular pores. Three feet divergent, striated, gradually lessening from a broad base, twice as long as the thorax, curved like a crescent, with convexity outwards.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—Fossil in Tertiary rocks of Barbados and the Mediterranean (Sicily, Greece).

### 13. *Lychnocanium fenestratum*, n. sp. (Pl. 61, fig. 10).

Shell pear-shaped, rough, with slight collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 3. Cephalis subglobular, with a very large prismatic horn, which is about as long as the shell, with three denticulate, prominent, wing-like crests, which are pierced by a series of pores. Thorax ovate, three times as broad as the constricted, prominent mouth, with subregular, circular pores. Three feet arising somewhat above the mouth, prismatic, with denticulate edges, about as long as the thorax, divergent, curved, with convexity outwards.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·08 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 14. *Lychnocanium sigmopodium*, n. sp. (Pl. 61, fig. 15).

? *Lychnocanium tetrapodium*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 3.

Shell campanulate, rough, with distinct collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 3. Cephalis subspherical, with a slender, pyramidal horn twice the length. Thorax inflated, conical, with regular, circular pores and a wide open mouth of nearly the same breadth. Three feet widely divergent, twice as long as the thorax, angular, S-shaped, or curved with convexity inwards. (*Lychnocanium tetrapodium* of Ehrenberg is perhaps a variety of this species ?).

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·08 long, 0·09 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, many stations at various depths; also fossil in Barbados and Sicily.

### 15. *Lychnocanium trichopus*, Ehrenberg.

*Lychnocanium trichopus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 5.

Shell conical, smooth, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis subspherical, with a rudimentary conical horn of half the length. Thorax campanulate, with regular, circular pores and wide open mouth of nearly the same breadth. Three feet divergent, very slender, four to five times as long as the thorax, not broader than one pore, S-shaped, or curved with convexity inwards in the distal half.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·07 long, 0·09 broad.

*Habitat.*—Fossil in Barbados.

## Subgenus 3. *Lychnocanoma*, Haeckel.

*Definition.*—Feet parallel, vertical, straight, or little curved; divergent in the basal half, often convergent in the distal half; their terminal distance about equal to the basal distance.

### 16. *Lychnocanium tripodium*, Ehrenberg.

*Lychnocanium tripodium*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 2.

Shell ovate, smooth, with distinct collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 4. Cephalis subglobular, with a slender conical horn twice the length. Thorax inflated, twice as broad as the constricted mouth, with small, regular, circular pores. Three feet slender, prismatic, twice to three times as long as the thorax, nearly straight and parallel, vertical.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·07 long, 0·07 broad.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms; also fossil in Barbados.

### 17. *Lychnocanium cypselus*, Ehrenberg.

*Lychnocanium cypselus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. vii. fig. 10.

Shell slender, ovate, with slight collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 3. Cephalis subspherical, with a conical horn of the same length. Thorax ovate, truncate, three times as broad as the narrow, constricted mouth, with small, regular, circular pores. Three feet slender, somewhat shorter than the thorax, little curved, with convexity outwards, nearly parallel, vertical. (In the specimen figured by Ehrenberg, the third foot was broken off.)

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

### 18. *Lychnocanium ovatum*, n. sp.

Shell ovate, rough, without external collar stricture. Length of the two joints = 1 : 6, breadth = 1 : 5. Cephalis conical, with a stout conical horn of the same length. Thorax ovate, four times as broad as the narrow constricted mouth, with small, regular, circular pores, separated by hexagonal frames of twice the breadth. Three feet cylindrical, half as long as the thorax, and three times as long as broad, straight, parallel, vertical.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax, 0·12 long, 0·1 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

19. *Lychnocanium crassipes*, Ehrenberg.

*Lychnocanium crassipes*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. vii. fig. 7.

Shell campanulate, rough, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subspherical, with a thin conical horn of the same length. Thorax semi-ovate, three times as broad as the narrow constricted mouth, with fifteen to twenty divergent, denticulate ribs, alternating with the same number of rows of small, regular, circular pores. Three feet very stout, as long as the thorax, cylindrical, nearly straight and parallel, vertical, at the distal end clavate, spinulate or a little forked.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

20. *Lychnocanium clavigerum*, n. sp. (Pl. 61, fig. 4).

Shell campanulate, sulcate, with sharp collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 5. Cephalis subglobular, with a spindle-shaped papillate horn twice the length. Thorax nearly spherical, truncate at both poles, three times as broad as the narrow, constricted, somewhat tubular mouth, with fifteen to twenty elevated meridional ribs, alternating with the same number of rows of circular pores. Three feet slender, cylindrical, twice as long as the thorax, in the basal half divergent, in the distal half convergent, club-shaped, with a thickened papillate end.

*Dimensions.*—Cephalis 0·02 long, 0·025 broad; thorax 0·08 long, 0·01 broad.

*Habitat.*—Indian Ocean, Madagascar, surface (Rabbe).

21. *Lychnocanium pudicum*, n. sp. (Pl. 61, fig. 2).

Shell campanulate, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis hemispherical, hyaline (without pores), with a short and thick club-shaped, spinulate horn of the same length. Thorax subglobular, truncate at both poles, twice as broad as the constricted mouth, with small, irregular, roundish pores. Three feet somewhat shorter than the thorax, curved like a crescent, with convexity outwards; their distal ends club-shaped, spinulate, convergent towards the central axis.

*Dimensions.*—Cephalis 0·02 long, 0·025 broad; thorax 0·06 long, 0·07 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 549. *Lychnodictyum*,[1] Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Sethopilida (vel Dicyrtida triradiata aperta), with three latticed terminal feet on the peristome, without thoracic ribs. Cephalis originally with a horn (sometimes lost).

[1] *Lychnodictyum* = Lantern with network; λύχνος, δίκτυον.

The genus *Lychnodictyum* differs from the preceding *Lychnocanium* only in the fenestration of the three terminal feet, and bears therefore to it the same relation that the ancestral *Tripocyrtis* does to *Dictyophimus*.

1. *Lychnodictyum challengeri*, Haeckel.

*Dictyopodium challengeri*, Wyville Thomson, 1877, Atlantic, vol. i. p. 234, fig. 52.
*Dictyophimus* (vel *Tripocyrtis*) *challengeri*, Haeckel, 1878, Protistenreich, p. 47, fig. 35.

Shell campanulate, smooth, with sharp collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis subspherical, with a large, oblique, pyramidal horn thrice the length. Thorax with three inflated bosoms between the three decurrent ribs, which are prolonged into three vertical, parallel, pyramidal, in the upper half fenestrated feet, as long as the thorax. Pores regular, circular. Mouth constricted, flat, half as broad as the thorax.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·08 long, 0·12 broad.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

2. *Lychnodictyum wyvillei*, n. sp.

Shell pyramidal, smooth, with obliterated collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 5. Cephalis subspherical, with a large, straight, pyramidal horn of twice the length. Thorax nearly tetrahedral, inflated, with three rounded, decurrent ribs, which are prolonged into three widely divergent, angular, curved feet, about as long as the shell, with pyramidal fenestrated base. Pores regular, circular. Mouth constricted, flat, half as broad as the thorax.

*Dimensions.*—Cephalis 0·025 diameter; thorax 0·08 long, 0·12 broad.

*Habitat.*—Central Pacific, Stations 266 to 274, depth 2350 to 2925 fathoms.

3. *Lychnodictyum scaphopodium*, n. sp. (Pl. 56, fig. 4).

Cephalis hemispherical, large, without horn, with irregular, small, roundish pores. Thorax a little larger, campanulate, with three broad, shovel-shaped, fenestrated, vertical feet, and larger, irregular pores. In the figured specimen the third (posterior) foot was broken off. In another specimen the three feet were somewhat longer and not so broad.

*Dimensions.*—Cephalis 0·03 long, 0·05 broad; thorax 0·05 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

4. *Lychnodictyum sethopodium*, n. sp.

Cephalis hemispherical, large, with a rudimentary conical horn, and very scarce small pores. Thorax twice as broad and long as the cephalis, campanulate, with irregular, roundish pores, and three slender, pyramidal, divergent feet twice the length, which in the upper half are fenestrated, in the lower half solid.

*Dimensions.*—Cephalis 0·025 long, 0·045 broad; thorax 0·05 long, 0·09 broad.

*Habitat.*—South Atlantic, Station 330, surface.

Subfamily 2. SETHOPERIDA, Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Tripocyrtida with the basal mouth of the shell fenestrated (vel Dicyrtida triradiata clausa).

Genus 550. *Sethopera*,[1] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa), with three divergent ribs enclosed in the latticed wall of the thorax. Cephalis with a horn.

The genus *Sethopera* is probably the oldest form of the Sethoperida, and may therefore be regarded as the common ancestral form of this subfamily. The thorax exhibits three radial ribs, which are completely enclosed in its wall. Sethopera may be derived either from *Dictyophimus* or from another of the Sethopilida (*Lamprodiscus*, *Clathrocanium*) by development of a basal lattice-plate closing the mouth). There are often wide holes or open spaces between the three radial ribs.

1. *Sethopera tricostata*, n. sp. (Pl. 97, fig. 11).

Cephalis subspherical, spinulate, with a pyramidal horn of the same length. Length of the two joints = 5 : 8, breadth = 5 : 8. Thorax also nearly spherical; in the upper half with three stout, prismatic, convex, divergent ribs, and three large ovate holes between them; in the lower half with numerous small and irregular pores, spinulate.

*Dimensions.*—Cephalis 0·05 diameter; thorax 0·08 diameter.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Sethopera oceania*, Haeckel.

*Lithopera oceania*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. iv. fig. 21.

Cephalis hemispherical, with a small bristle-shaped horn of half the length (broken off in Ehrenberg's figure). Length of the two joints = 3 : 4, breadth = 3 : 4. Thorax nearly spherical; in the upper half with three divergent ribs, separated by some larger, irregular pores; in the lower half with numerous small, irregular, roundish pores.

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·04 long, 0·04 broad.

*Habitat.*—North Atlantic, Station 354, surface; Canary Islands and Azores.

3. *Sethopera pyrum*, Haeckel.

? *Lithopera pyrum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297.

Cephalis hemispherical, with a small conical horn of half the length. Length of the two joints = 3 : 10, breadth = 3 : 7. Thorax pear-shaped, with rather large, regular, quincuncial pores;

[1] *Sethopera* = Sieve-pouch; σήθω, πήρα.

its upper half with three divergent ribs in the wall, half as broad as the subspherical lower half. (The three ribs probably were overlooked by Ehrenberg.)

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·1 long, 0·07 broad.

*Habitat.*—North Pacific, Station 256, surface; Californian Sea, 2600 fathoms, Ehrenberg.

4. *Sethopera lagena*, Haeckel.

*Lithopera lagena*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 4.

Cephalis pear-shaped, with a small conical horn of half the length. Length of the two joints = 3 : 8, breadth = 3 : 6. Thorax smooth, pear-shaped, with irregular roundish pores; in the wall of its upper third three divergent thin ribs (sometimes wanting); the lower half inflated. (Compare *Sethocapsa lagena*.)

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

## Genus 551. *Lithopera*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa), with three divergent ribs enclosed in the cavity of the thorax. Cephalis with a horn.

The genus *Lithopera* is, like the preceding *Sethopera*, one of the most simple and oldest forms of the Sethoperida, and exhibits three divergent thoracic ribs, which are prolonged neither into lateral wings nor into basal feet. But whilst in *Sethopera* the three ribs are enclosed in the lattice-work of the shell-wall, in *Lithopera* they lie freely in its cavity, and are overgrown by the enveloping shell-wall, being inserted on its inner face with their distal ends. *Lithopera* may be derived directly from *Lithomelissa*, by development of lattice-work closing the shell-mouth. Therefore the lower part of the cephalis is hidden in the uppermost part of the thorax; only its upper part is free.

1. *Lithopera bacca*, Ehrenberg.

*Lithopera bacca*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. viii. fig. 1.

Cephalis spherical, with small, irregular pores and a bristle-shaped spine of half the length; its lower half hidden in the thorax. Length of the two joints = 1 : 6, breadth = 1 : 5. Thorax ellipsoidal, smooth, with regular, hexagonal, small pores, and very thin, thread-like bars. From the deep collar stricture there arise three internal, divergent bars, which are inserted at the uppermost third of the thorax.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·12 long, 0·1 broad.

*Habitat.*—Tropical Pacific, Stations 200, 224, 266, 271, &c., surface.

[1] *Lithopera* = Stone-pouch; λίθος, πήρα.

2. *Lithopera bursella*, Ehrenberg.

*Lithopera bursella*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. x. fig. 4.

Shell of about the same form and structure as in the nearly allied preceding species, but smaller, of more slender form, with smaller pores and thinner bars. Length of the two joints = 1 : 5, breadth = 1 : 3. In the specimen observed by me the three internal, divergent bars of the ellipsoidal thorax (not seen by Ehrenberg) were as distinct as in the similar preceding and following species.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·1 long, 0·06 broad.

*Habitat.*—Indian Ocean, Zanzibar (Pullen), Madagascar (Rabbe), surface.

3. *Lithopera ananassa*, n. sp. (Pl. 57, fig. 3).

Shell of about the same form and structure as in the two preceding species, but larger and more robust, and differing in the spiny surface. Length of the two joints = 1 : 5, breadth = 1 : 4. Here also the lower half of the spherical cephalis is submerged in the ellipsoidal thorax, and from the collar stricture arise three strong, internal, divergent beams. The bars of the hexagonal pores are much thicker than in the two preceding species.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·16 long, 0·12 broad.

*Habitat.*—Tropical Atlantic, Stations 347 to 352, surface.

4. *Lithopera globosa*, n. sp.

Cephalis spherical, very small, with two divergent conical horns of half the length; its lower half hidden in the thorax. Length of the two joints = 1 : 5, breadth = 1 : 5. Thorax spherical, with regular, circular, hexagonally-framed pores. From the collar stricture arise three radial internal beams, horizontally diverging, and inserted at the inside of the thorax.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·15 diameter.

*Habitat.*—Central Pacific, Stations 271, depth 2425 fathoms.

5. *Lithopera gutta*, Ehrenberg.

*Lithopera gutta*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. viii. fig. 2.

Shell pear-shaped, with sharp collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 3. Cephalis spherical, with a conical horn of the same length; its lower half hidden in the uppermost part of the ovate thorax, and connected with its wall by three internal, cortinar beams. Pores of the thorax very irregular in form and size, partly lobed.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·08 long, 0·06 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms; Philippine Sea (depth 3300 fathoms), Ehrenberg.

Genus 552. *Micromelissa*,[1] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa), with three divergent, solid, lateral wings. Cephalis with a horn.

The genus *Micromelissa* differs from the two preceding genera in the free prominence of the three cortinar ribs, forming three solid lateral wings. Beyond these the thorax walls are convergent, and the basal mouth closed by a lattice-plate. Therefore *Micromelissa* may have arisen from *Lithomelissa* simply by development of this basal mouth-plate.

1. *Micromelissa bombus* n. sp. (Pl. 57, fig. 14).

Shell smooth, with sharp collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 5. Cephalis spherical, with an oblique conical horn of the same length. Thorax subspherical, in the upper half with three conical, downwardly diverging wings, about as long as its radius. Pores very small and scarce.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·09 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Micromelissa vespa*, n. sp.

Shell smooth, with deep collar stricture. Length of the two joints = 2 : 5, breadth = 2 : 3. Cephalis spherical, with an oblique pyramidal horn twice the length. Thorax inversely ovate, in the upper half with three pyramidal wings, which are equal to its breadth, little curved and diverging downwards. Pores very small and scarce.

*Dimensions.*—Cephalis 0·04 diameter; thorax 0·1 long, 0·06 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

3. *Micromelissa apis*, n. sp.

Shell rough, with deep collar stricture. Length of the two joints = 2 : 3, breadth = 2 : 4. Cephalis subspherical, with a straight conical horn of half the length, and subregular, circular, double-contoured pores, of the same breadth as the bars. Thorax little larger, subspherical, with irregular, roundish pores, twice to four times as broad as the bars. From its lower half arise three short conical wings, curved downwards, and half as long as the cephalis.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

[1] *Micromelissa* = Small bee; *μικρός*, *μέλισσα*.

4. *Micromelissa microptera*, Haeckel.

*Lithomelissa microptera*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 2; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 78, Taf. iii. fig. 13.

*Lithomelissa microptera*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 539, Taf. xxxiii. fig. 26.

Shell smooth, with distinct collar stricture. Length of the two joints = 4 : 6, breadth = 3 : 5. Cephalis ovate, with a straight sword-shaped horn of the same length and very small pores, some larger ones above the stricture. Thorax little larger, ovate, nearly hyaline, with very few and small scattered pores. From its uppermost part arise three short conical wings, scarcely half as long as the cephalic horn, little curved and divergent downwards.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·06 long, 0·05 broad.

*Habitat.*—Fossil in Barbados.

5. *Micromelissa ventricosa*, Haeckel.

*Lithomelissa ventricosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 11.

Shell rough, with slight collar stricture. Length of the two joints = 1 : 7, breadth = 1 : 5. Cephalis small, hemispherical, with a small conical horn of half the length, Thorax ovate, very large, papillate, with irregular, roundish pores. From its basal part arise three short and stout conical wings at great distances, shorter than the cephalis. (A transition-form to *Sethocapsa*.)

*Dimensions.*—Cephalis 0·02 long, 0·022 broad; thorax 0·14 long, 0·11 broad.

*Habitat.*—Fossil in Barbados.

## Genus 553. *Peromelissa*,[1] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa) with three divergent solid lateral wings. Cephalis without horn.

The genus *Peromelissa* differs from the preceding ancestral form, *Micromelissa*, only in the absence of the cephalic horn, which is lost by reduction.

1. *Peromelissa phalacra*, n. sp. (Pl. 57, fig. 11).

Shell smooth, with two joints of nearly equal size and similar ovate form. Cephalis in the upper half hyaline, without pores; in the lower half with four remote, transverse rows of irregular, roundish pores, decreasing in size towards the hemispherical summit. Thorax with twelve transverse

[1] *Peromelissa* = Pouch-bee; πήρα, μέλισσα.

rows of pores, the upper six rows three to four times as large as the lower six rows. From its upper half diverge almost horizontally three angular club-shaped wings, half as long as the shell.

*Dimensions.*—Cephalis 0·05 long, 0·06 broad; thorax 0·06 long, 0·05 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Peromelissa psilocrana*, n. sp.

Shell smooth, very similar to the preceding species in size and form, but differing from it in the disposition of the irregular, roundish pores, which are irregularly scattered, and in the form of the three wings, which are slender, pyramidal, diverging downwards, and about as long as the entire shell.

*Dimensions.*—Cephalis 0·07 long, 0·06 broad; thorax 0·07 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Peromelissa capito*, Haeckel.

*Lithomelissa capito*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss.-Berlin, p. 78, Taf. iii. fig. 14.

Shell rough, with two joints of nearly equal size and similar ovate form. Pores irregular, roundish, everywhere scattered. From the upper half of the thorax arise three short conical wings, which are little curved and diverge downwards (scarcely half as long as the breadth of the shell).

*Dimensions.*—Cephalis 0·07 long, 0·06 broad; thorax 0·07 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

4. *Peromelissa calva*, n. sp. (Pl. 57, fig. 12).

Shell rough, with two ovate joints of somewhat different sizes. Pores irregular, roundish, everywhere scattered. Thorax little larger than the cephalis; from its upper half arise three short conical wings, diverging downwardly or nearly horizontally.

*Dimensions.*—Cephalis 0·06 long, 0·04 broad; thorax 0·7 long, 0·05 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

Genus 554. *Sethomelissa*,[1] Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa) with three divergent latticed lateral wings. Cephalis with a horn (or a bunch of horns).

The genus *Sethomelissa* differs from the nearly allied *Micromelissa* in the fenestration of the three lateral wings, and may be derived either from this genus by development of lattice-work connecting the three wings with the shell, or perhaps from *Clathrocanium* by closing the mouth.

[1] *Sethomelissa* = Sieve-bee; σήθω, μέλισσα.

1. *Sethomelissa hymenoptera*, n. sp.

Cephalis subspherical, thorny, with a bunch of three divergent, larger apical spines. Thorax pear-shaped, with three broad, triangular, latticed wings, the superior edge of which is a horizontal straight, and stout spine, nearly as long as the thorax. Pores irregular, roundish.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·11 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 555. *Tetrahedrina*,[1] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa) with a three-sided pyramidal thorax, the three edges of which are prolonged into three divergent, solid, terminal feet. Cephalis with a horn.

The genus *Tetrahedrina*, and the two following nearly allied genera, are distinguished by the possession of three free, divergent, terminal feet, projecting over the latticed mouth of the thorax. *Tetrahedrina* may be derived directly from *Dictyophimus*, by development of a horizontal latticed mouth-plate from the middle part of the feet, the lower part of which remains free. This genus, not noticed by Ehrenberg, is similar to his *Lithochytris*, and common in the Barbados deposits.

1. *Tetrahedrina pyramidalis*, n. sp.

Shell three-sided pyramidal, smooth, with slight collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 4. Cephalis hemispherical, with small, sparsely disposed pores, and a pyramidal horn of the same length. Thorax with subregular, circular pores and three sharp edges, prolonged into three divergent pyramidal feet of the same length.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·12 long, 0·12 broad.

*Habitat.*—Fossil in Barbados.

2. *Tetrahedrina pyriformis*, n. sp.

Shell pear-shaped, rough, with distinct collar stricture. Length of the two joints = 2 : 6, breadth = 2 : 5. Cephalis subspherical, with a conical horn of the same length. Thorax with subregular, circular pores, ovate, at the broad base with three pyramidal, widely divergent feet of the same length. (Similar to *Lychnocanium tribulus*, Ehrenberg, 1875, *loc. cit.*, pl. vii. fig. 1, but with the mouth closed by a lattice-plate.)

*Dimensions.*—Cephalis 0·04 diameter; thorax 0·12 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

[1] *Tetrahedrina* = Small tetrahedron; τετρά-εδρον.

3. *Tetrahedrina quadricornis*, Haeckel.

*Lithochytris triangula*, Bury, 1862, Polycystins of Barbados, pl. xix. figs. 4, 5, 6.

Shell pear-shaped, papillate, with slight collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 5. Cephalis subspherical, with a stout conical horn twice the length. Thorax with irregular, roundish, lobulated pores, with three conical, stout, divergent feet at the base, of the same size and form as the cephalic horn.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·1 long, 0·1 broad.

*Habitat.*—Fossil in Barbados.

## Genus 556. *Sethochytris*,[1] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa) with three terminal latticed feet or hollow, fenestrated, divergent, basal apophyses of the thorax. Cephalis with a horn.

The genus *Sethochytris* differs from the preceding *Tetrahedrina* in the fenestration of the three basal feet, which form direct protrusions or evaginations of the three basal corners of the pyramidal shell. It may be derived from *Sethopera* by centrifugal growth of the basal corners.

1. *Sethochytris triconiscus*, n. sp. (Pl. 57, fig. 13).

Shell rough, with deep collar stricture. Length of the two joints = 1 : 8, breadth = 1 : 3. Cephalis spherical, with an oblique pyramidal horn of the same length. Thorax campanulate, conical; its three basal corners prolonged into three divergent, slender, hollow, fenestrated cones, twice as long as the thorax, and ending in a stout pyramidal spine.

*Dimensions.*—Cephalis 0·04 diameter, thorax 0·12 diameter, length of the feet 0·2.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

2. *Sethochytris barbadensis*, Haeckel.

*Lithochytris barbadensis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 160, Taf. v. fig. 2.

Shell smooth, with slight collar stricture. Length of the two joints = 1 : 6, breadth = 1 : 4. Cephalis ovate, with a conical horn of half the length. Thorax conical; its base prolonged into three divergent, hollow, fenestrated cones, half as long as the thorax. Pores small, subregular, circular.

*Dimensions.*—Cephalis 0·025 diameter, thorax 0·1 diameter, length of the feet 0·05.

*Habitat*—Fossil in Barbados.

[1] *Sethochytris* = Sieve-pot; σήθω, χυτρεῖς.

3. *Sethochytris pyramis*, n. sp.

Shell smooth, with slight collar stricture. Length of the two joints = 1 : 8, breadth = 1 : 5. Cephalis ovate, with a conical horn of half the length. Thorax pyramidal, with three sharp edges; its base prolonged into three pyramidal, divergent, hollow, fenestrated feet, nearly as long as the thorax. Pores regular, circular, double-contoured.

*Dimensions.*—Cephalis 0·04 diameter; thorax 0·2 diameter, length of the feet 0·15.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; also fossil in Barbados.

4. *Sethochytris triangula*, Haeckel.

*Lithochytris triangula*, Bury, 1862, Polycystins of Barbados, pl. xix. fig. 7.

Shell rough, with obliterated collar stricture (but distinct internal collar septum). Length of the two joints = 1 : 6, breadth = 1 : 3. Cephalis subspherical, with a stout conical horn of the same length. Thorax pear-shaped, inflated; its base prolonged into three divergent, hollow, fenestrated cones, about as long as the thorax. Pores regular, circular.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·09 diameter, length of the feet 0·1.

*Habitat.*—Fossil in Barbados.

Genus 557. *Clathrolychnus*,[1] Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Sethoperida (vel Dicyrtida triradiata clausa), with three vertical, lateral latticed wings stretched between the apical horn and the three terminal feet. The external lattice-work connecting the wings and closing the mouth forms an arachnoidal mantle around the shell.

The genus *Clathrolychnus* may be derived directly from *Clathrocorys*, by development of an external arachnoidal mantle connecting the three wings and the three feet, and enveloping the whole shell, closing at the same time the basal mouth of the thorax by a fenestrated plate.

1. *Clathrolychnus araneosus*, n. sp. (Pl. 64, fig. 5).

Cephalis subspherical, with irregular, polygonal pores and a large pyramidal horn of twice the length. Length of the two joints = 4 : 9, breadth = 5 : 12. Thorax with three large triangular holes (twice as broad as the cephalis) between the three pyramidal, divergent feet, which at the distal end are connected by a narrow band of network, composed of two or three rows of polygonal pores. The entire pyramidal shell is enveloped by a very delicate web of irregular, polygonal

[1] *Clathrolychnus* = Fenestrated lantern; κλῆθρα, λύχνος.

meshes, closing also the basal mouth. (In fig. 5 the greater part of the web is taken off to demonstrate the large holes of the thorax). Only two feet are visible.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·09 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 274, surface.

2. *Clathrolychnus periplectus*, n. sp. (Pl. 64, fig. 6).

Cephalis subspherical, with subregular, circular pores and a pyramidal horn of the same length. Length of the two joints = 1 : 2, breadth = 1 : 3. Thorax with three large elliptical holes between the three pyramidal, divergent feet, which are connected at the distal end by a broad band of network, composed of five to ten rows of polygonal pores. The entire pyramidal shell is enveloped by a very delicate web, which on the sides is composed of subregular, square meshes, and on the closed mouth of polygonal meshes. (In fig. 6 only a part of the web is represented.)

*Dimensions.*—0·04 long, 0·05 broad; thorax 0·08 long, 0·14 broad.

*Habitat.*—Central Pacific, Station 271, surface.

## Family LXIII. ANTHOCYRTIDA, n. fam.

*Sethophormida et Sethophænida*, Haeckel, 1881, Prodromus, p. 432, 433.

*Definition.*—Dicyrtida multiradiata. (Cyrtoidea with a two-jointed shell, divided by a transverse constriction into cephalis and thorax, and bearing numerous—four to nine or more—radial apophyses.)

The family Anthocyrtida, composed of the Sethophormida and Sethophænida of my Prodromus, comprises those Cyrtoidea in which the shell is two-jointed and bears numerous radial apophyses. The two subfamilies differ in the shape of the mouth, which in the Sethophormida is a simple, wide opening; in the Sethophænida closed by a lattice-plate.

Numerous fossil and living forms of Anthocyrtida were described formerly by Ehrenberg in his genera *Carpocanium* and *Anthocyrtis*. These, however, represent only a small part of the whole family, which exhibits a great variety in the composition of the lattice-work and in the number of radial beams. The number of species here described amounts to one hundred and forty, and these are disposed in fourteen genera (twelve Sethophormida and two Sethophænida).

The Sethophormida may be again divided into two different groups or tribes, the *Sethamphorida* and *Carpocanida;* in the former the thorax bears numerous radial ribs, enclosed in its wall; in the latter these ribs have disappeared, and only a corona of terminal feet is developed around the mouth. The shell of the former is usually pyramidal, with a widely open mouth; of the latter ovate, with a constricted mouth. The mouth of the thorax becomes perfectly closed in the Sethophænida.

The majority of the Anthocyrtida may be derived from the Polyspyrida (*Petalospyris*, &c.) by reduction of the cephalis and loss of the sagittal ring, as was suggested by Bütschli (1882, *loc. cit.*). But another part may also have arisen from the Tripocyrtida, by interpolation of secondary radial apophyses between the three primary perradial apophyses. The cephalis in this family is developed in all possible degrees, from one of a considerable size to one very much reduced. If it becomes perfectly lost, the Cyrtocalpida arise.

*Synopsis of the Genera of Anthocyrtida.*

| | | | | | |
|---|---|---|---|---|---|
| I. Subfamily Sethophormida. Terminal mouth of the thorax a simple wide opening. | Radial ribs smooth (rarely thorny) enclosed in the wall of the thorax (cephalis commonly small, without horns). | Shell flat, campanulate or nearly discoidal (cephalis without horn), | | | 558. *Sethophormis.* |
| | | Shell ovate, with constricted mouth (without horn), | | | 559. *Sethamphora.* |
| | | Shell slender pyramidal, with straight ribs. | Meshes of the network simple, | | 560. *Sethopyramis.* |
| | | | Meshes fenestrated by secondary latticework, | | 561. *Plectopyramis.* |
| | | | Meshes closed by spongy framework, | | 562. *Spongopyramis.* |
| | Radial ribs thorny (rarely smooth) prolonged into free terminal feet (cephalis commonly large, with one or more horns). | Shell not enveloped by arachnoidal network, | | | 563. *Acanthocorys.* |
| | | Shell enveloped by arachnoidal network, | | | 564. *Arachnocorys.* |
| | No ribs in the thorax. Peristome with free terminal feet. | Cephalis well-developed, with an apical horn. | Feet terminal, without separate peristome. | Six feet, | 565. *Anthocyrtoma.* |
| | | | | Nine feet, | 566. *Anthocyrtis.* |
| | | | | Twelve or more feet, | 567. *Anthocyrtium.* |
| | | | Feet subterminal, outside the constricted peristome, | | 568. *Anthocyrtidium.* |
| | | Cephalis rudimentary, hidden in the upper part of the thorax, without horn, | | | 569. *Carpocanium.* |
| II. Subfamily Sethophænida. Terminal mouth closed by a lattice-plate. | Thorax with lateral apophyses (four to six or more wings), | | | | 570. *Sethophæna.* |
| | Thorax with terminal apophyses (four to six or more feet), | | | | 571. *Clistophæna.* |

Subfamily 1. SETHOPHORMIDA, Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Anthocyrtida with the basal mouth of the shell open (vel Dicyrtida multiradiata aperta).

Genus 558. *Sethophormis*, Haeckel,[1] 1881, Prodromus, p. 432.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) with numerous radial ribs in the wall of the flat and broad, campanulate or nearly discoidal thorax. Cephalis also flat and broad, cap-shaped, without horn.

The genus *Sethophormis* comprises a great number of widely distributed and large Dicyrtida, all agreeing in the flat cap-shaped or nearly discoidal form of the thorax, which has constantly a very delicate network, and is pierced by numerous radial beams. Four of these are commonly primary and direct prolongations of the four cortinar rods in the collar septum, whilst the others are secondary or interpolated ribs. *Sethophormis* may be derived either from the triradial *Lamprodiscus* by multiplication of the ribs (or interpolation of secondary ribs between the three primary), or from *Halicalyptra* by development of transverse rods connecting its terminal feet, and forming a ribbed thorax. Corresponding to the number of the ribs, we may distinguish as subgenera (separate genera in my Prodromus, 1881, p. 432) *Tetraphormis* with four, *Pentaphormis* with five, *Hexaphormis* with six, *Octophormis* with eight, *Enneaphormis* with nine, and *Astrophormis* with ten to twenty or more ribs. The cephalis bears no horn, and is usually large, flat, cap-shaped or hemispherical.

Subgenus 1. *Tetraphormis*, Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Thorax with four radial ribs, opposite in pairs in two meridional planes, perpendicular to one another. Collar septum with four large pores.

1. *Sethophormis cruciata*, n. sp.

Cephalis very large, hemispherical, with irregular, delicate network of small square meshes. Thorax flatly campanulate, with delicate, regular network of small hexagonal meshes. All bars very thin, thread-like. Four stout radial thoracic ribs, crossed in pairs, lie in two meridional planes, perpendicular to one another. Very similar to *Sethophormis aurelia* (Pl. **55**, figs. 3, 4), but not so flat, and with only four thoracic ribs. Peristome or margin of the thoracic mouth smooth, circular.

*Dimensions.*—Cephalis 0·04 long, 0·08 broad; thorax 0·12 long, 0·36 broad.

*Habitat.*—Central Pacific, Station 271, surface.

[1] *Sethophormis* = Sieve-basket.; σήθω, φορμίς.

2. *Sethophormis medusa*, n. sp.

Cephalis very large, flat, cap-shaped, with irregular, delicate network of polygonal meshes. Thorax flat, campanulate, nearly hemispherical, with delicate, irregular network of small polygonal meshes. All bars very thin, thread-like. Four stout radial thoracic ribs, as in the preceding species. Peristome denticulate.

*Dimensions.*—Cephalis 0·03 long, 0·09 broad; thorax 0·15 long, 0·25 broad.

*Habitat.*—North Pacific, Station 244, surface.

Subgenus 2. *Pentaphormis*, Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Thorax with five radial ribs, one of the three primary ribs (the odd occipital rib) being simple, the two others (the paired lateral ribs) forked.

3. *Sethophormis pentalactis*, n. sp. (Pl. 56, fig. 5).

Cephalis large, flat, hemispherical, with subregular, hexagonal pores. Thorax flat, campanulate, nearly hemispherical; also with subregular, hexagonal pores, and with five stout ribs. The three primary ribs of the thorax are complete, and reach the peristome; the two secondary ribs (as basal branches of the two lateral ribs) are incomplete and absent in the distal half of the thorax. Peristome denticulate, with an elegant marginal corona of small square pores and short conical spines.

*Dimensions.*—Cephalis 0·03 long, 0·06 broad; thorax 0·1 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

4. *Sethophormis asteriscus*, n. sp.

Cephalis large, flat, cap-shaped, with irregular polygonal pores. Thorax flat, campanulate, with subregular, hexagonal pores, and five stout ribs. The marginal distance between the two anterior (lateral) ribs is twice as great as the distance between every two other ribs (the postero-lateral ribs being basal branches of the antero-lateral ribs). Peristome with a double corona of short, conical spines.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·06 long, 0·17 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

5. *Sethophormis astrodiscus*, n. sp.

Cephalis small, flatly vaulted, cap-shaped, with irregular, polygonal pores. Thorax very flatly vaulted, nearly discoidal, with subregular, hexagonal pores, and five stout ribs. The marginal distance between all five ribs is nearly equal. Peristome denticulate, with an elegant corona of small square pores and short conical thorns.

*Dimensions.*—Cephalis 0·015 long, 0·035 broad; thorax 0·05 long, 0·2 broad.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

Subgenus 3. *Hexaphormis*, Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Thorax with six radial ribs (three primary perradial and three secondary interradial beams).

6. *Sethophormis hexalactis*, n. sp. (Pl. 56, fig. 6).

Cephalis large, hemispherical, with irregular, polygonal pores. Thorax flatly campanulate, with subregular, hexagonal pores, and six stout radial ribs; the lateral connected in pairs. (Fig. 6 exhibits the central part of the shell, seen from below.) In the subcircular collar septum the two anterior (jugular) meshes are much smaller than the two posterior (cardinal) meshes. The odd anterior (sternal) rib is opposite to the posterior (caudal) rib. The two paired ribs of each side (antero-lateral or pectoral and postero-lateral or ventral ribs) diverge from one common point. In the specimen figured the left half of the thorax exhibited the two regular ribs, and the right half three, a posterior accessory branch being developed (transition to *Octophormis*). This specimen might indeed be called *Heptaphormis heptalactis*.

*Dimensions.*—Cephalis 0·02 long, 0·05 broad; thorax 0·08 long, 0·22 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

7. *Sethophormis hexagonalis*, n. sp.

Cephalis small, flat, cap-shaped, with small, regular, hexagonal pores. Thorax flatly conical, nearly discoidal, with larger pores of the same form, and six stout, straight, prominent ribs. These arise at equal distances from the six corners of the hexagonal base of the collar septum. Peristome hexagonal, with a corona of short spines.

*Dimensions.*—Cephalis 0·015 long, 0·04 broad; thorax 0·06 long, 0·24 broad.

*Habitat.*—North Atlantic, Station 354, surface.

Subgenus 4. *Octophormis*, Haeckel.

*Definition.*—Thorax with eight radial ribs, four secondary interradial beams being interpolated between the four primary perradial beams of *Tetraphormis*.

8. *Sethophormis octalactis*, n. sp.

Cephalis large, hemispherical, with irregular, polygonal pores. Thorax flatly campanulate, with regular, hexagonal pores, and eight stout, regularly-disposed, radial ribs reaching the margin at equal distances. Four of these correspond to the four primary ribs of *Tetraphormis cruciata*, and exhibit at their base a larger pair of basal pores, surrounded by a semicircular ring (Pl. 70, fig. 5); the other four are secondary, interpolated. Peristome circular, simple.

*Dimensions.*—Cephalis 0·03 long, 0·06 broad; thorax 0·1 long, 0·22 broad.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

Subgenus 5. *Enneaphormis*, Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Thorax with nine radial ribs, three of which are the primary beams, the other six being secondary and interpolated.

9. *Sethophormis rotula*, n. sp. (Pl. 57, fig. 9).

*Enneaphormis rotula*, Haeckel, 1881, Prodromus et Atlas, pl. lvii. fig. 9.

Cephalis very large, flat, cap-shaped, trilobed, with irregular, polygonal network. Horizontal collar-ring stout, hexagonal, with three larger and three alternate smaller sides of half the length. From the middle of the three larger sides arise three horizontal, centripetal, radial beams, which are united in the centre of the collar-septum—the three primary cortinar beams. These are prolonged outside into three centrifugal primary ribs of the thorax. From the six corners of the collar-ring arise six other secondary, thoracic ribs, equal in size and similar in form to the three primary. Each of these nine equal, straight ribs of the thorax is thickened towards the distal end, and bears at equal distances five pairs of opposite (tangential) lateral branches. The opposite branches of the neighbouring spines become united, and lie nearly horizontally in one plane, so that the flat, discoidal thorax is like a nine-angled wheel with nine equally distant spokes and five concentric, nine-angled rings.

*Dimensions.*—Cephalis 0·12 diameter, thorax 0·36 diameter.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

10. *Sethophormis triloba*, n. sp.

Cephalis large, hemispherical, distinctly trilobed, with dense, irregular, polygonal network. From the centre of its top diverge three stout arches or semilunar rods, which are curved downwards, and unite with the three horizontal, radial beams of the collar-septum inside the collar-ring. These three parietal arches of the cephalis are much stronger than in the similar preceding species (Pl. 57, fig. 9), and between them are placed three vaulted bosoms of the cephalis. The collar-ring and the thorax are of the same form as in the preceding, but possess only four concentric, nine-angled rings.

*Dimensions.*—Cephalis 0·05 long, 0·08 broad; thorax 0·24 diameter.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

11. *Sethophormis enneastrum*, n. sp.

Cephalis very large, flat, cap-shaped, with hexagonal base, trilobed, of similar form and structure to the two preceding species. The flat, discoidal thorax has also the same form, with nine stout ribs and five concentric, nine-angled rings; its forty-five large meshes, however, are not so simple

as these (Pl. 57, fig. 9), but are subdivided into irregular, smaller meshes by interpolated radial beams connecting the concentric rings.

*Dimensions.*—Cephalis 0·1 diameter, thorax 0·3 diameter.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

12. *Sethophormis arachnium*, n. sp.

Cephalis very large, flat, cap-shaped, trilobed, with hexagonal base, of the same structure as in the three preceding species. The flat discoidal thorax is also similar, and has the same structure as in the preceding species (Pl. 57, fig. 9); but the number of concentric, nine-angled rings is raised from five to eight, and in its outer part nine secondary radial beams are interpolated between the nine primaries, so that the peristome has not nine but eighteen corners.

*Dimensions.*—Cephalis 0·08 diameter, thorax 0·4 diameter.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

13. *Sethophormis enneactis*, n. sp.

Cephalis small, hemispherical, with small, irregular, polygonal pores. Thorax flatly pyramidal, nearly discoidal, with nine prominent, stout ribs, which are connected by numerous (twelve to sixteen) horizontal, nine-angled rings. In the outer half of the thorax there are nine weaker secondary ribs interpolated between the nine stronger primaries, and eighteen shorter and feebler tertiary ribs between the former and the latter. Peristome denticulated, nine-angled.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·08 long, 0·24 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

14. *Sethophormis eupilium*, n. sp. (Pl. 56, fig. 9).

*Sethopyramis eupilium*, Haeckel, 1882, Atlas, pl. lvi. fig. 9.
*Craspedilium eupilium*, Haeckel, 1878, Manuscript.

Cephalis very small, hemispherical, hyaline, without pores. Thorax flatly pyramidal, with nine concave, triangular faces and nine little curved, stout, radial beams. Between these are interpolated numerous incomplete secondary beams, which are absent in the apical part of the thorax. The radial beams being connected by numerous (thirty to forty or more) horizontal, ring-like threads, a delicate, arachnoidal network with small, quadrangular pores is produced. Peristome nine-angled, with a peculiar vertical gallery, composed of four horizontal, parallel, nine-angled rings, which are connected by numerous vertical, parallel bars, therefore with three transverse rows of square pores. This peculiar species is very different from the preceding and may represent a separate genus, *Craspedilium*.

*Dimensions.*—Cephalis 0·01 diameter, thorax 0·1 long, 0·25 broad.

*Habitat.*—Central Pacific, Station 271, surface.

Subgenus 6. *Astrophormis*, Haeckel.

*Definition.*—Thorax with a variable number of radial ribs (twelve to twenty or more).

15. *Sethophormis aurelia*, n. sp. (Pl. 55, figs. 3, 4).

*Leptarachnium aurelia*, Haeckel, 1879, Manuscript et Atlas.

Cephalis large, nearly hemispherical, with irregular, delicate network of small square meshes. Collar-septum with four large meshes, separated by a cross of four bars, opposite in pairs. Thorax flatly campanulate, with delicate, subregular, hexagonal meshes, and twenty-four prominent radial ribs; four of these are primary or perradial (centrifugal prolongations of the four bars of the collar-septum); four others are interradial or secondary, alternating with the former at angles of 45°; sixteen others are adradial or tertiary, interpolated between the first and second more or less irregularly. In some specimens the disposition of the twenty-four ribs was more regular, in others more irregular, than in the specimen figured (figs. 3, 4). The central capsule (fig. 4) exhibits a flat, cap-shaped part with the nucleus (enclosed in the cephalis), and four large, pear-shaped lobes protruded through the four large collar holes (somewhat deformed in the preparation figured). The wall of the thorax exhibits at the base four larger, nearly semicircular pores, bisected by the four primary thoracic ribs. Peristome with twenty-four indentations (between the prominent distal ends of the twenty-four ribs), often more distinct than in the specimen figured.

*Dimensions.*—Cephalis 0·03 long, 0·08 broad; thorax 0·1 to 0·2 long, 0·4 to 0·6 broad.

*Habitat.*—Central Pacific, Station 263 to 274, depth 2350 to 2925 fathoms.

16. *Sethophormis dodecaster*, n. sp. (Pl. 56, fig. 12).

Cephalis small; flatly cap-shaped, with irregular, small, roundish pores. Thorax flatly conical, nearly of the same shape as in the preceding species, but only with twelve prominent ribs; four primary or perradial ribs (as prolongations of the four crossed cortinar bars), and eight adradial ribs interpolated between the former, and arising at some distance from the collar ring. Peristome with twelve prominent pointed lobes (supported by the distal ends of the twelve ribs), and with twelve semicircular bosoms between them. (The specimen figured is young and not fully developed.)

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·1 long, 0·3 broad.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

17. *Sethophormis umbrella*, n. sp. (Pl. 70, figs. 4, 5).

Cephalis large, flatly cap-shaped, with irregular, small polygonal meshes. Thorax flat, umbrella-shaped, with subregular, hexagonal meshes, and sixteen strong radial ribs. Four of these are perradial, and centrifugal prolongations of the four crossed collar beams; four others are interradial, and

arise, alternating with the former, directly from the horizontal collar ring; eight ribs are adradial or tertiary, and arise in pairs from the four large perradial basal arches of the thorax, which become bisected by the four primary ribs. Peristome irregularly denticulate.

*Dimensions.*—Cephalis 0·02 long, 0·06 broad; thorax 0·12 long, 0·32 broad.

*Habitat.*—North Pacific (off Japan), Stations 236 to 239, surface.

18. *Sethophormis floscula*, n. sp.

Cephalis small, hemispherical, with subregular, small hexagonal pores. Thorax flatly conical, with larger hexagonal meshes and twenty-four ribs; four of these are perradial and prolongations of the four collar bars; four interradial arise from the collar ring between the former, alternating with them. Each of these eight main ribs gives off two more or less irregular, lateral branches (one at each side), altogether sixteen. The thorax is similar to *Cladarachnium ramosum* (Pl. **55**, fig. 5), whilst the cephalis is quite different. Peristome with twenty-four prominent triangular lobes.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·1 long, 0·4 broad.

*Habitat.*—South Atlantic, Station 325, surface.

19. *Sethophormis leptoscenium*, n. sp.

Cephalis very small, spherical, with few small, circular pores. Thorax flatly conical or tent-shaped, with concave lateral outlines, small hexagonal meshes, and numerous (thirty to forty or more) strong, little curved, simple radial ribs. Peristome nearly circular, with a corona of small, irregular, conical spines.

*Dimensions.*—Cephalis 0·015 diameter; thorax 0·07 long, 0·26 broad.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

20. *Sethophormis leptopilium*, n. sp.

Cephalis very small, subspherical, hyaline, without pores. Thorax flatly conical or hat-shaped, with concave lateral outlines, and a very delicate network of small square meshes (similar to *Litharachnium araneosum*, Pl. **55**, fig. 8). This is supported by thirty-two curved radial ribs, four of which are primary, four secondary, and the other twenty-four interpolated. Peristome horizontally expanded and little recurved, like the reflexed brim of a hat.

*Dimensions.*—Cephalis 0·12 diameter; thorax 0·08 long, 0·24 broad.

*Habitat.*—South Pacific, Station 291, depth 2250 fathoms.

## Genus 559. *Sethamphora*,[1] n. gen.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) with numerous curved ribs in the wall of the ovate thorax, the small mouth of which is constricted. Cephalis without horn.

[1] *Sethamphora* = Sieve-pitcher; σήθω, ἀμφορεύς.

The genus *Sethamphora* differs from the preceding *Sethophormis*, and from the next following ribbed Sethophormida, mainly in the small, more or less constricted mouth; therefore the thorax is more or less ovate, and its ribs curved, with the convexity external. *Sethophormis* may be divided into two different subgenera, *Dictyoprora* and *Cryptocephalus*; in the former the cephalis is perfectly free and well developed, in the latter it is more or less hidden in the uppermost part of the thorax (like *Carpocanium*).

### Subgenus 1. *Dictyoprora*, Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Cephalis large, perfectly free, not hidden in the thorax.

#### 1. *Sethamphora hexapleura*, n. sp.

Shell ovate, smooth, with distinct collar stricture. Length of the two joints = 3 : 11, breadth = 5 : 10. Cephalis large, free, hemispherical, with small circular pores. Thorax truncate, ovate, with six strong curved ribs, and six large triangular meshes between them in the upper half; five smaller pores between every two ribs in the lower half (in three tiers); therefore, together, thirty-six thoracic meshes. Mouth strongly constricted, smooth, only one-third as broad as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·05 broad; thorax, 0·11 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

#### 2. *Sethamphora enneapleura*, n. sp.

Shell subovate, smooth, with slight collar stricture. Length of the two joints = 3 : 9, breadth = 4 : 8. Cephalis large, hemispherical, free, with small circular pores. Thorax inflated, ovate, with nine strong curved ribs, which are connected by five transverse circular rings at equal distances. Forty-five rounded, squarish, large meshes between them, in five transverse and nine longitudinal rows. Mouth constricted, smooth, half as broad as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

#### 3. *Sethamphora dodecapleura*, n. sp.

Shell urceolate, smooth, with sharp collar stricture. Length of the two joints = 3 : 9, breadth = 5 : 9. Cephalis flat, cap-shaped, free, with twelve ribs, and very small pores between them. Thorax thick-walled, inflated, with subcylindrical cavity, and twelve prominent sharp ribs, alternating with twelve longitudinal rows of very small circular pores (eight pores in each row). Mouth constricted, half as broad as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·05 broad; thorax 0·09 long, 0·09 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

4. *Sethamphora mongolfieri*, Haeckel.

*Eucyrtidium mongolfieri*, Ehrenberg, 1854, Mikrogeol., Taf. xxxiv. fig. 18; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 72, Taf. x. fig. 3.

Shell urceolate, smooth, with distinct collar stricture. Length of the two joints = 2 : 9, breadth = 3 : 7. Cephalis campanulate, with eighteen ribs and small pores. Thorax nearly ellipsoidal, with eighteen prominent ribs, and eighteen longitudinal rows of regular circular pores between them (eight pores in each row; therefore 144 pores altogether). Mouth constricted, only one-third as broad as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·09 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

5. *Sethamphora costata*, n. sp.

Shell urceolate, smooth, very similar to the preceding species; also with eighteen longitudinal ribs, but differing in the larger size of the cephalis and its pores, and in the more slender and ovate form of the thorax. Length of the two joints = 5 : 10, breadth = 5 : 8. Pores of the cephalis more numerous. Mouth half as broad as the thorax.

*Dimensions.*—Cephalis 0·05 long, 0·05 broad; thorax 0·1 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 265 to 274, depth 2350 to 2925 fathoms.

6. *Sethamphora serrata*, n. sp.

Shell ovate, spinulate, without external collar stricture. Length of the two joints = 1 : 6, breadth = 2 : 4. Cephalis flat, cap-shaped, with small circular pores. Thorax ovate, truncate, with eighteen serrate longitudinal ribs, alternating with eighteen longitudinal rows of short and broad rather oblong pores (twenty to thirty pores in each row). Mouth strongly constricted, only one-fourth as broad as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·12 long, 0·08 broad.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

7. *Sethamphora ampulla*, Haeckel.

*Eucyrtidium ampulla*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 15; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 72, Taf. x. figs. 11, 12.

Shell broad, urceolate, spiny, with sharp collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 5. Cephalis subspherical, with few small pores (in figs. 12*a* and 12*b* of Ehrenberg, *loc. cit.*, broken off, so that the four pores of the cortinar septum appear). Thorax inflated, bottle-shaped, with twenty prominent, sharply dentate ribs, alternating with twenty longitudinal rows of circular pores (about eight pores in each row). Mouth flat, constricted, one-third as broad as the thorax.

*Dimensions.*—Cephalis 0·025 long, 0·03 broad; thorax 0·1 long, 0·14 broad.

*Habitat.*—Fossil in Barbados.

8. *Sethamphora aërostatica*, Haeckel.

*Podocyrtis aërostatica*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvi. fig. 4.

Shell broad, urceolate, smooth, with sharp collar stricture. Length of the two joints = 2 : 6, breadth = 3 : 8. Cephalis hemispherical, large, with few pores (broken off in fig. 4*a* of Ehrenberg, so that the six collar pores appear). Thorax inflated, bottle-shaped, with twenty-two to twenty-four smooth prominent ribs, alternating with the same number of longitudinal rows of small circular pores. Mouth very small, strongly constricted, scarcely as broad as the cephalis, with three short teeth.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

Subgenus 2. *Cryptocephalus*, Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Cephalis more or less hidden in thorax, being partly enveloped by its uppermost part.

9. *Sethamphora microstoma*, n. sp. (Pl. 57, fig. 5).

*Cryptoprora microstoma*, Haeckel, Atlas, pl. lvii., fig. 5.

Shell ovate, smooth, without external collar stricture. Length of the two joints = 1 : 6, breadth = 2 : 4. Cephalis flat, cap-shaped, without ribs, with small circular pores. Thorax ovate, with twenty-four prominent ribs, alternating with deep longitudinal furrows, each of which contains a series of about fifteen small circular pores. Mouth very small, representing a short cylindrical tube, which is only one-eighth as broad as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·12 long, 0·08 broad.

*Habitat.*—Western Tropical Pacific, Station 220, depth 1100 fathoms.

10. *Sethamphora favosa*, n. sp. (Pl. 57, fig. 4).

*Cryptocephalus favosus*, Haeckel, 1881, Prodromus, p. 430.

Shell ovate, dimply. Length of the two joints = 1 : 5, breadth = 1 : 5. Cephalis subspherical, small, completely hidden in the thickened top of the thorax (but very distinct in the longitudinal section). Thorax ovate, with twenty-five to thirty longitudinal ribs, alternating with the same number of longitudinal furrows, each of which contains ten to twelve circular, hexagonally framed pores. In the smooth wall of the peristome only twelve triangular ribs are visible. Mouth constricted, one-third as broad as the thorax.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·1 long, 0·09 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

Genus 560. *Sethopyramis*,[1] Haeckel, 1881, Prodromus, p. 432 (sensu emendato !)

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) with numerous straight or slightly curved radial ribs in the wall of the pyramidal thorax. Network simple. Cephalis commonly without horn.

The genus *Sethopyramis* and the four following genera form together a peculiar small group (Sethopyramida), characterised by the slender pyramidal shell, in the wall of which numerous (six to nine or more) radial ribs are enclosed. These ribs may be regarded as the terminal feet of a *Calpophæna* or *Halicalyptra*, which become connected by transverse bars. *Sethopyramis* may be derived also directly from *Patagospyris* by loss of the primary sagittal ring and reduction of the cephalis.

Subgenus 1. *Sestropyramis*, Haeckel.

*Definition.*—Pyramidal shell with six radial main beams (sometimes also five or seven, as individual varieties).

1. *Sethopyramis scalaris*, Haeckel.

*Cornutella scalaris*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 1.

Shell smooth, slenderly pyramidal, hexagonal. Cephalis large, subglobular, hyaline, without pores (or with very small and scarce pores). Thorax with six straight (or little curved) stout longitudinal ribs or radial beams, which are connected by twenty to thirty complete, hexagonal, horizontal rings. The large meshes so produced are regular, square, their length and breadth equally and gradually increasing towards the mouth.

*Dimensions.*—Cephalis 0·04 diameter; thorax (with twenty-four transverse rings) 0·4 long, 0·15 broad at the mouth.

*Habitat.*—Fossil in Barbados.

2. *Sethopyramis hexalactis*, n. sp.

Shell thorny, of the same form as, and similar structure to, the preceding species, but differing in the spiny surface and the smaller subglobular cephalis, which bears small circular pores and an oblique conical horn twice the length. The whole surface is covered with short conical thorns.

*Dimensions.*—Cephalis 0·02 diameter; thorax (with twenty transverse rings) 0·25 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

Subgenus 2. *Cephalopyramis*, Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Pyramidal shell with nine radial main beams (sometimes also eight or ten, as individual varieties).

[1] *Sethopyramis* = Sieve-pyramid; σήθω, πυραμίς.

3. *Sethopyramis enneactis*, n. sp. (Pl. 56, fig. 7).

*Cephalopyramis enneactis*, Haeckel, 1881, Prodromus et Atlas, pl. lvi. fig. 7.

Shell smooth, slender, pyramidal. Cephalis large, ovate, with pointed apex, nearly hyaline, with very few and small scattered pores. Thorax very slenderly pyramidal, with straight lateral outlines, and nine stout and straight radial beams, which are connected by fifteen to twenty horizontal complete rings. Meshes subregular, square, simple, without secondary network; their length and breadth equally increasing towards the mouth.

*Dimensions.*—Cephalis 0·05 long, 0·03 broad; thorax (with twenty transverse rings) 0·24 long, 0·1 broad at the mouth.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

4. *Sethopyramis quadrata*, n. sp. (Pl. 54, fig. 2).

Shell smooth, slenderly pyramidal, very similar in form and structure to the preceding species; differing from it in the rudimentary cephalis, which is very small, hemispherical, with few small porules. The three internal cortinar bars of the collar stricture are present; when they become lost this species passes over into *Bathropyramis quadrata* (Pl. 54, fig. 1).

*Dimensions.*—Cephalis 0·01 long, 0·02 broad; thorax (with ten transverse rings) 0·15 long, 0·1 broad at the mouth.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

5. *Sethopyramis quadratella*, Haeckel.

*Cornutella quadratella*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 2.

*Litharachnium quadratella*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 540, Taf. xxxiii. fig. 37.

Shell smooth, broadly pyramidal. Cephalis ovate, small, blunt, hyaline, with very few and small pores (in the figure of Ehrenberg broken off). Thorax broadly pyramidal, with straight lateral outlines, and nine stout and straight radial beams, which are connected by eight to twelve horizontal complete rings. Meshes in the upper half regular, square, in the lower half broad, rectangular (in the tenth transverse row twice as broad as long).

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax (with ten transverse rings) 0·15 long, 0·15 broad.

*Habitat.*—Fossil in Barbados.

6. *Sethopyramis trapezoides*, n. sp.

Shell smooth, broadly pyramidal. Cephalis large, ovate, hyaline, without pores; its collar septum exhibits distinctly the four collar pores (two larger cardinal and two smaller jugular pores).

Thorax broad, pyramidal, with slightly concave lateral outlines and nine (sometimes eight or ten) curved ribs, which are connected by eighteen to twenty-four complete transverse rings. The large meshes, so produced, have the form of a parallel trapezoid, and are in the eighth transverse row three times as broad as long. (Differs from *Bathropyramis trapezoides*, Pl. **54**, fig. 3, mainly by the possession of a well developed cephalis).

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax (with eighteen rings) 0·32 long, 0·24 broad.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

7. *Sethopyramis spinosa*, n. sp.

Shell thorny, slender, pyramidal. Cephalis small, subspherical, with few small pores and a straight, vertical, conical horn twice the length. Thorax with nine straight ribs, which are connected by sixteen to twenty complete transverse nine-angled rings. The large meshes so produced are subregular, square. From each nodal point a short conical spine arises. (Differs from the similar *Bathropyramis spinosa*, Pl. **54**, fig. 4, by the development of the cephalis and the simple pointed, unforked spines.)

*Dimensions.*—Cephalis 0·03 diameter; thorax (with sixteen rings) 0·2 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

8. *Sethopyramis hexagonalis*, n. sp.

Shell papillate, slender, pyramidal. Cephalis small, hemispherical, with a straight conical horn twice the length, and small circular pores. Thorax conical, with slightly convex outlines and nine stout, somewhat curved ribs in zig-zag form, which are connected by ten to twelve interrupted transverse bars. From each nodal point a small conical papilla arises. The large meshes so produced are regular, hexagonal, gradually increasing in size towards the mouth.

*Dimensions.*—Cephalis 0·03 diameter; thorax (with twelve transverse rows of meshes) 0·18 long, 0·12 broad.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

9. *Sethopyramis cyclomma*, n. sp.

Shell thorny, slender, pyramidal. Cephalis large, subspherical, with numerous very small circular pores, and a small conical horn of the same length. Thorax similar in form and structure to that of the preceding species; but each hexagonal mesh is provided with a very thin circular hyaline ring (like a diaphragm), so that the openings are not hexagonal, but circular. From each nodal point a short pointed conical or slightly forked spine arises.

*Dimensions.*—Cephalis 0·02 diameter; thorax (with ten transverse rows of meshes) 0·18 long, 0·14 broad.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

Subgenus 3. *Actinopyramis*, Haeckel.

*Definition.*—Pyramidal shell with twelve or more radial beams (commonly twelve to twenty-four, sometimes forty or more).

10. *Sethopyramis dodecalactis*, n. sp.

Shell smooth, slender, pyramidal. Cephalis small, spherical, hyaline, with a short conical horn. Thorax with twelve radial ribs in the upper half, between which twelve others are interpolated in the lower half. These are connected by twenty to twenty-four complete transverse rings. The meshes so produced are subregular, rectangular.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·6 long, 0·2 broad.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

11. *Sethopyramis bicornis*, n. sp.

Shell spiny, slender, pyramidal. Cephalis small, spherical, hyaline, with two divergent conical horns, the major (occipital) three times and the minor (frontal) twice as long. Thorax slender, pyramidal, campanulate, thorny, with twenty to thirty radial beams, which are little curved, convex in the upper, concave in the lower half, and connected by numerous interrupted transverse bars. Meshes in the upper third rounded, in the lower two-thirds quadrangular, of very different sizes. Surface covered with spinules.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·9 long, 0·4 broad.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

12. *Sethopyramis maxima*, n. sp.

Shell smooth, slender, pyramidal. Cephalis small, spherical, with few small pores, and a stout, vertical, conical horn twice the length. Thorax very prolonged, conical, with straight lateral outlines and numerous (twenty to fifty) radial beams (in the upper third twelve, in the middle third twenty-four, in the lower third forty to fifty, by interpolation); they are connected by very numerous interrupted transverse bars. Meshes subregular, quadrangular. Surface smooth.

*Dimensions.*—Cephalis 0·02 diameter; thorax 1·05 long, 0·45 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 561. *Plectopyramis*,[1] Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) with numerous straight or slightly curved radial ribs in the wall of the pyramidal thorax. Network double, the large primary meshes being fenestrated by fine secondary network. Cephalis commonly without horn.

[1] *Plectopyramis* = Woven pyramid; πλεκτός, πυραμίς.

The genus *Plectopyramis* differs from the preceding *Sethopyramis*, its ancestral form, only in the peculiar double fenestration of the shell, the large primary meshes of which are separated by strong bars, and filled up by a very delicate arachnoidal network, composed of small pores and very thin threads between them. This double lattice-work often exhibits a very remarkable regularity. As in the preceding genus, the number of radial ribs is commonly six or nine, rarely twelve to twenty or more.

### Subgenus 1. *Hexapleuris*, Haeckel.

*Definition.*—Pyramidal shell with six radial main beams (sometimes five or seven in individual varieties).

1. *Plectopyramis magnifica*, Haeckel.

*Polycystina magnifica*, Bury, 1862, Polycystins of Barbados, pl. xi. fig.

Shell smooth, slender, pyramidal. Cephalis large, ovate, pointed, separated from the thorax by a very deep collar stricture, with few irregular pores. Thorax with six strong and straight radial beams, which are connected by about twenty horizontal, hexagonal rings. The large meshes so produced are regular, square, and filled up by an extremely delicate secondary arachnoidal network, composed of regular square pores (as in Pl. **54**, figs. 7, 8).

*Dimensions.*—Cephalis 0·06 long, 0·04 broad; thorax (with twenty transverse rings) 0·4 long, 0·12 broad.

*Habitat.*—Fossil in Barbados.

2. *Plectopyramis hexapleura*, n. sp.

Shell thorny, slender, pyramidal. Cephalis large, ovate, blunt, with deep collar stricture. Thorax with six strong and straight radial beams, which are connected by numerous (twenty to thirty) interrupted transverse bars. The large meshes so produced are irregular, quadrangular, and filled up by irregular, delicate, secondary network, with small polygonal pores.

*Dimensions.*—Cephalis 0·05 long, 0·03 broad; thorax 0·3 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### Subgenus 2. *Enneapleuris*, Haeckel.

*Definition.*—Pyramidal shell with nine radial main beams (sometimes eight or ten in individual varieties).

3. *Plectopyramis dodecomma*, n. sp. (Pl. 54, fig. 6).

Shell smooth, slenderly pyramidal, with straight outlines. Cephalis conical, obtuse, with thirty-six small square pores (in nine divergent longitudinal rows, each of four pores). Collar septum (between cephalis and thorax) with four distinct collar pores. Thorax pyramidal, with nine very stout and straight angular radial beams, which are connected by ten to fifteen broad horizontal nine-angled rings. Each of the large regular, square meshes so produced contains a very delicate fenestration, with twelve regular, square pores, separated by two transverse and three longitudinal crossed threads. A very regular and remarkable structure.

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax (with ten rings) 0·2 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Plectopyramis quadratomma*, n. sp.

Shell smooth, slenderly pyramidal. Cephalis large, ovate, hyaline, with few very small basal pores and deep collar stricture. Thorax pyramidal, with straight outline, and nine very stout and straight radial beams, which are connected by fifteen to twenty horizontal nine-angled rings. Each of the large regular, square meshes so produced is filled up by a very delicate arachnoidal network, with very numerous and small square pores (as in the similar *Cinclopyramis infundibulum*, Pl. 54, fig. 7, which differs in the loss of the cephalis).

*Dimensions.*—Cephalis 0·05 long, 0·03 broad; thorax (with fifteen rings) 0·32 long, 0·2 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

5. *Plectopyramis trapezomma*, n. sp. (Pl. 54, fig. 8).

Shell smooth, broadly pyramidal, with concave lateral outlines. Cephalis hemispherical, small, with numerous small, circular pores. Thorax pyramidal, with nine stout, concavely curved radial beams, which are connected by twelve to sixteen horizontal nine-angled rings. The large meshes so produced are in the upper half square, in the lower half parallel trapezoid (in the fifteenth ring three times as broad as long), and filled up by a secondary arachnoidal network, with very numerous and small square pores.

*Dimensions.*—Cephalis 0·015 long, 0·025 broad; thorax (with fifteen rings) 0·22 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

6. *Plectopyramis polygonomma*, n. sp.

Shell smooth, pyramidal, very similar to the preceding species; differing from it in the irregular shape of the delicate polygonal (not tetragonal) secondary network, filling up the large rectangular meshes. The cephalis is larger, hyaline, pear-shaped, pointed, without pores, with a deep collar stricture. The nine radial beams of the thorax are less concave.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax (with fifteen rings) 0·3 long, 0·22 broad.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

7. *Plectopyramis heteromma*, n. sp.

Shell smooth, slenderly pyramidal, with concave outlines. Cephalis very small, subspherical, with a small oblique, conical horn, and very small, scarce circular pores. Thorax with nine stout concavely curved radial beams, which are connected by numerous (thirty to fifty or more) interrupted transverse bars. The large irregular meshes so produced are filled up by irregular, polygonal, delicate lattice-work.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·6 long, 0·3 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

8. *Plectopyramis serrata*, n. sp.

Shell thorny, slenderly pyramidal, with straight outlines. Cephalis very small, spherical, with a long oblique, conical horn, and very small circular pores. Thorax with nine stout, straight, regularly serrate ribs or radial beams, which are connected by numerous (twenty to thirty or more) interrupted transverse bars. The latter, being crossed by intercalated and interrupted irregular radial beams, produce a subregular secondary network of rectangular meshes of different sizes.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax, 0·3 long, 0·2 broad.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

9. *Plectopyramis fenestrata*, Haeckel.

*Pyramis fenestrata*, Bury, 1862, Polycystins of Barbados, pl. xxi. fig. 8.

Shell thorny, broadly pyramidal, with straight outlines. Cephalis very small, spherical, hyaline. Thorax with nine stout, spinulate, straight ribs or radial beams, which are connected by ten to fifteen transverse bars, which in the upper half are complete rings, in the lower half interrupted, and crossed by irregularly intercalated radial beams. Meshes therefore irregular, quadrangular. All the bars are thorny.

*Dimensions.*—Cephalis 0·01 diameter; thorax 0·2 long, 0·16 broad.

*Habitat.*—Tropical Atlantic.

10. *Plectopyramis furcata*, n. sp.

Shell spiny, slenderly pyramidal, with straight outlines. Cephalis small, spherical, with few small pores. Thorax with nine stout and straight spinulate ribs, which are connected by a variable number of irregular interrupted transverse bars; the large quadrangular meshes so produced are filled up by irregular delicate network. The entire surface of the thorax is covered with short forked spines.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·3 long, 0·2 broad.

*Habitat.*—Indian Ocean (Zanzibar), Pullen, depth 2200 fathoms.

### Subgenus 3. *Polypleuris*, Haeckel.

*Definition.*—Pyramidal shell with numerous (twelve or more) radial main beams (commonly twelve to eighteen, sometimes twenty to thirty or more).

#### 11. *Plectopyramis polypleura*, n. sp. (Pl. 56, fig. 8).

Shell smooth, slenderly conical, with straight outlines. Cephalis small, subspherical, with very small dot-like pores, and an oblique conical horn twice the length. Thorax with numerous (twenty to thirty) divergent longitudinal ribs; usually twelve of these radial beams appear as stronger, primary main ribs, and twelve to eighteen other as secondary, feebler, interpolated ribs. They are crossed by numerous (twenty to forty or more) horizontal rings. The large meshes so produced are quadrangular, and partly filled up by a very delicate secondary network, with small square pores.

*Dimensions.*—Cephalis 0·03 diameter; thorax 0·36 long, 0·24 long.

*Habitat.*—Central Pacific, Station 267, depth 2700 fathoms.

#### 12. *Plectopyramis lagena*, n. sp.

Shell smooth, wine-bottle shaped, or slenderly conical-campanulate, with bent outlines, which are concave in the upper, convex in the lower half. Cephalis very small, spherical, hyaline, without pores. Thorax with twenty-four radial ribs, twelve stronger primary, alternating with twelve feebler secondary. They are crossed by interrupted transverse bars. The irregular quadrangular meshes so produced are filled up by a delicate, irregular, secondary network.

*Dimensions.*—Cephalis 0·02 diameter; thorax 0·5 long, 0·3 broad.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

### Genus 562. *Spongopyramis*,[1] n. sp.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) with numerous straight or slightly curved radial ribs in the wall of the pyramidal thorax. Network spongy. Cephalis commonly without horn.

The genus *Spongopyramis* has arisen from *Sethopyramis* by development of an irregular spongy framework around the lattice-shell, and is one of the small number of Cyrtoidea in which the shell-wall exhibits a spongy structure. In both observed species the cephalis is small, but evident.

[1] *Spongopyramis*=Spongy pyramid; σπόγγος, πυραμίς.

1. *Spongopyramis spongiosa*, n. sp. (Pl. 56, fig. 10).

*Plectopyramis spongiosa*, Haeckel, 1881, Prodromus et Atlas, *loc. cit.*

Shell partly or entirely enveloped by spongy framework, slender, pyramidal, with rather straight outlines. Cephalis very small, ovate, hyaline. Thorax with nine very stout and nearly straight ribs, which are connected by fifteen to twenty or more irregular, interrupted transverse bars. The irregular quadrangular meshes so produced are filled up by an irregular secondary network, with meshes of very different size and form. The dense spongy envelope, which in the specimen figured covered only half the shell, was complete in another older specimen.

*Dimensions.*—Cephalis 0·015 long, 0·01 broad; thorax 0·4 long, 0·25 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Spongopyramis spongoplecta*, n. sp.

Shell entirely enveloped by spongy framework, pyramidal, with straight outlines. Cephalis ovate (twice as large as in the preceding species), with small circular pores. Thorax with twelve stout and straight ribs, which are connected by twenty to twenty-five annular, transverse bars. The subregular square meshes so produced are filled up by irregular, spongy network, which envelops the whole shell more loosely than in *Spongopyramis spongiosa*.

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax 0·5 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 563. *Acanthocorys*,[1] Haeckel, 1881, Prodromus, p. 432.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) with numerous radial ribs in the wall of the pyramidal thorax, prolonged into divergent terminal feet. Network simple. Cephalis commonly with several horns.

The genus *Acanthocorys* and the following nearly allied *Arachnocorys* possess a near relation to the three preceding pyramidal genera, but differ from them in the terminal prolongation of the radial ribs, which are commonly spiny and form a corona of free feet around the mouth of the thorax. The cephalis is usually much larger than in the three preceding genera, and bears a variable number of radial horns. Therefore these two genera are probably older and nearer to the common ancestral form of the Sethophormida than the preceding genera. It may be derived directly from *Dictyophimus* by interpolation of three secondary (interradial) ribs between the three primary (perradial) ribs.

[1] *Acanthocorys* = Spiny helmet; ἄκανθα, κόρυς.

## Subgenus 1. *Acanthocorallium*, Haeckel.

*Definition.*—Thorax with six divergent ribs or radial beams (three primary or perradial alternating with three secondary or interradial).

### 1. *Acanthocorys hexapodia*, n. sp.

Cephalis large, ovate, with subregular hexagonal pores, and six strong, conical, simple, divergent horns of the same length. Thorax flat, conical, smooth, with six large triangular basal holes, separated by six strong, prismatic, smooth beams, which are connected only near the distal end by a hexagonal ring of delicate, irregular network. Collar septum with three meshes, separated by the three centripetal prolongations of the three primary ribs.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·12 long, 0·24 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

### 2. *Acanthocorys pristipodia*, n. sp.

Cephalis large, hemispherical, with irregular, polygonal pores, and numerous (ten to twenty) bristle-shaped, radiating horns, which are conical at the base, and twice as long. Thorax flatly campanulate, thorny, with six strong, serrate or spinulate, divergent, radial ribs, prolonged into six free conical feet of the same length. Meshes of the thorax irregular, polygonal, a corona of six larger ones at the base. Collar septum with four meshes, shaped as in Pl. **56**, fig. 6.

*Dimensions.*—Cephalis 0·04 long, 0·06 broad; thorax 0·08 long, 0·18 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 3. *Acanthocorys macropodia*, n. sp.

Cephalis small, subspherical, with irregular, roundish pores and numerous small, bristle-shaped horns. Length of the two joints = 1 : 2, breadth = 1 : 6. Thorax sexangular, pyramidal, with six very long and straight, widely divergent feet, which are prismatic and spiny, and three to five times as long as the breadth of the shell. Only the upper third of the six ribs is connected by irregular, roundish network, with six large triangular holes at the base. Collar septum with four meshes which have the same relation to the six ribs as in *Sethophormis hexalactis* (Pl. **56**, fig. 6).

*Dimensions.*—Cephalis 0·025 diameter, thorax 0·05 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 271, surface.

### 4. *Acanthocorys bütschlii*, Haeckel.

? *Clathrocanium ehrenbergii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 514, 539, Taf. xxxii. fig. 18, *a*, *b*.

Cephalis large, subspherical, with numerous small, circular pores and three to six divergent, slender, apical horns. Thorax flatly conical, smooth, not much larger than the cephalis, with six-

large, triangular or ovate basal holes between the six ribs. Three of these ribs are primary or perradial, and arise immediately from the collar septum, alternating with three secondary or interradial ribs, which arise more outside. The specimen observed by me exhibited six apical horns, and was more complete than that figured by Bütschli, the six ribs being prolonged over the connecting lattice-girdle into six short, divergent feet.

*Dimensions.*—Cephalis 0·06 long, 0·06 broad; thorax 0·08 long, 0·1 broad.

*Habitat.*—Fossil in Barbados.

### Subgenus 2. *Acanthocoronium*, Haeckel.

*Definition.*—Thorax with nine divergent ribs or radial beams, three of which are primary or perradial, the other six secondary or interradial.

#### 5. *Acanthocorys umbellifera*, Haeckel.

*Arachnocorys umbellifera*, Haeckel, 1862, Monogr. d. Radiol., p. 305, Taf. vi. fig. 12.

Cephalis large, ovate, with subregular, circular pores and numerous divergent, simple spines of different lengths. Thorax flatly conical, with nine strong, divergent ribs, which in the distal half are free, in the proximal half connected by numerous transverse beams, forming irregular polygonal meshes. Dorsal face of the thorax armed with scattered ascending spines.

*Dimensions.*—Cephalis 0·05 long, 0·035 broad; thorax 0·05 long, 0·12 broad.

*Habitat.*—Mediterranean (Messina); Atlantic, Station 354, surface.

#### 6. *Acanthocorys triloba*, n. sp.

Cephalis large, campanulate, trilobed, with irregular, roundish pores, numerous spines, and a large pyramidal horn on the top, which is connected by three constricted arches with the base of the horizontal collar beams. From the latter arise as centrifugal prolongations three stout, curved, primary ribs of the flatly vaulted thorax, and each of these gives off at the base two opposite, lateral, secondary ribs. These nine ribs are spiny, and connected by irregular, arachnoidal network.

*Dimensions.*—Cephalis 0·05 long, 0·07 broad; thorax 0·08 long, 0·18 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

#### 7. *Acanthocorys enneapodia*, n. sp.

Cephalis large, ovate, with irregular roundish pores, and numerous divergent, ascending spines. Thorax smooth, conical, little larger, with the same network, and nine larger, triangular holes at the base; with nine straight, equally-disposed ribs, which are prolonged into slender feet twice the length. With these latter alternate nine shorter radial spines, arising from the truncate peristome.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·05 long, 0·09 broad.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

8. *Acanthocorys macroceras*, n. sp. (Pl. 97, fig. 12).

Cephalis large, hemispherical, spiny, with regular, circular pores, and a very large, cylindrical, vertical horn five times as long as the whole shell. Thorax spiny, campanulate, with irregular, roundish pores and nine strong, curved ribs, prolonged into nine slender, divergent feet twice the length, which are curved, convex in the proximal half and concave in the distal half.

*Dimensions.*—Cephalis 0·05 long, 0·08 broad; thorax 0·12 long, 0·2 broad.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

9. *Acanthocorys furcata*, n. sp.

Cephalis large, subspherical, spiny, with irregular, roundish pores. Thorax flatly conical, thorny, with irregular, polygonal pores, decreasing in size towards the mouth, and with nine straight divergent ribs, which at the peristome are forked and prolonged into eighteen slender, very long, bristle-shaped feet.

*Dimensions.*—Cephalis 0·045 diameter, thorax 0·07 long, 0·13 broad.

*Habitat.*—South Atlantic, Station 323, depth 1900 fathoms.

## Subgenus 3. *Acanthocorythium*, Haeckel.

*Definition.*—Thorax with a variable number (ten to twenty or more) radial ribs, prolonged into free terminal feet.

10. *Acanthocorys dodecaster*, n. sp.

Cephalis small, subspherical, with small circular pores and a large conical horn of twice the length, and some accessory spines. Thorax thorny, flatly campanulate, with twelve stout curved ribs, which at the peristome are prolonged into twelve slender, curved feet of twice the length; four of them are centrifugal prolongations of the four cortinar beams separating the four large meshes of the collar septum; eight other ribs are secondary, interpolated in pairs between the former. At the base of the thorax are twelve large triangular holes between the ribs; the other network is irregular, with polygonal meshes.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·05 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

11. *Acanthocorys polypodia*, n. sp.

Cephalis small, hemispherical, with small, roundish pores and divergent radial spines. Thorax flatly conical, spiny, with twenty to twenty-four divergent, straight ribs, which in the proximal

third are separated by the same number of large, triangular meshes, in the middle third connected by irregular network, in the distal third free.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·06 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

## Genus 564. *Arachnocorys*,[1] Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 837.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) with numerous radial ribs in the wall of the pyramidal thorax, prolonged into divergent terminal feet. Network double, with an arachnoidal outer mantle around the inner lattice-shell. Cephalis commonly with numerous horns.

The genus *Arachnocorys* has been derived from the preceding *Acanthocorys*, by development of numerous external siliceous threads which connect the radial horns of the cephalis with the secondary spines arising from the thoracic ribs. In this way there becomes formed an outer arachnoidal framework, enveloping loosely, like a delicate mantle, the inner primary lattice-shell.

### Subgenus 1. *Arachnocorallium*, Haeckel.

*Definition.*—Thorax with six divergent ribs or radial beams (three primary or perradial, alternating with three secondary or interradial).

1. *Arachnocorys hexaptera*, n. sp.

*Arachnocorys circumtexta* (juv.?), R. Hertwig, 1879, Organism. d. Radiol., p. 79, Taf. viii. fig. 2*a*.

Cephalis large, subspherical, with irregular, polygonal pores, and numerous bristle-shaped spines twice the length; on the centre of the top a single larger vertical horn. Thorax flatly conical, with six strong and straight widely divergent ribs, which in the proximal half are separated by six large holes, in the distal half connected by a broad ring of irregular network. From each rib arises a perpendicular branch, and these branches are connected together, and with the spines of the cephalis, by arachnoidal network.

*Dimensions.*—Cephalis 0·04 diameter, thorax 0·08 long, 0·24 broad.

*Habitat.*—Central Pacific, Station 266; Mediterranean, surface.

2. *Arachnocorys discoides*, n. sp.

Cephalis small, pyramidal, with irregular, roundish pores and numerous thin spines, on the top a single larger vertical horn. Thorax very flat, nearly discoidal, with six strong and straight ribs,

[1] *Arachnocorys* = helmet with a cobweb; ἀράχνη, κόρυς.

which by communication of few larger and numerous smaller branches form an irregular network with polygonal meshes. From each of the six ribs arise two or three larger, perpendicular branches of half the length, and from the network numerous smaller spines. All these dorsal spines of the shell are connected by a dense arachnoidal wicker-work.

*Dimensions.*—Cephalis 0·02 diameter, thorax 0·04 long, 0·3 broad.

*Habitat.*—Central Pacific, Station 271, surface.

## Subgenus 2. *Arachnocoronium*, Haeckel.

*Definition.*—Thorax with nine divergent ribs or radial beams, three of which are primary or perradial, the other six secondary or interradial. (Sometimes eight or ten occur instead of the nine normal ribs.)

### 3. *Arachnocorys circumtexta*, Haeckel.

*Arachnocorys circumtexta*, Haeckel, 1862, Monogr. d. Radiol., p. 304, Taf. vi. figs. 9–11.
*Arachnocorys circumtexta*, R. Hertwig, 1879, Organism. d. Radiol., p. 78, Taf. viii. fig. 2.

Cephalis large, subspherical, with numerous roundish pores, and eight to ten slender, conical horns twice the length. Thorax flatly conical, with nine strong, straight, widely divergent, conical feet, each of which bears in the middle of its outer side a perpendicular ascending branch of half the length. These branches and the horns of the cephalis are connected by very thin, parallel, arachnoidal threads. Network of the thorax irregular, with nine larger triangular holes at the base. Collar septum with numerous, irregular, roundish pores.

*Dimensions.*—Cephalis 0·04 to 0·05 diameter, thorax 0·08 to 0·12 long, 0·15 to 0·25 broad.

*Habitat.*—Mediterranean (Messina); Atlantic, Stations 347 to 354, surface.

### 4. *Arachnocorys enneaptera*, n. sp.

Cephalis large, campanulate, with irregular, polygonal pores, two larger stout pyramidal and numerous slender, bristle-shaped horns. Thorax of the same structure as in the preceding species, only the nine basal holes are of twice the size; the lower network denser (as in *Clathrocanium diadema*, Pl. 64, fig. 2). Collar septum with numerous, irregular, roundish pores.

*Dimensions.*—Cephalis 0·05 diameter, thorax 0·12 long, 0·22 broad.

*Habitat.*—Tropical Atlantic, Station 338, surface.

### 5. *Arachnocorys araneosa*, n. sp. (Pl. 56, fig. 11).

Cephalis large, subspherical, with circular, subregular, hexagonally framed pores, and twenty to thirty slender, cylindrical, straight radial spines. Thorax flatly conical, nearly of the same shape as in the two preceding species, but with nine longer ribs, and more irregular, broader network between them. From the middle of each rib arises, nearly horizontally, a strong branch, which is directed

outwards. These branches are connected with the spines of the cephalis as well as with the distal half of the ribs, by dense and delicate arachnoidal network, composed of parallel, very thin, siliceous threads (in fig. 11 only partially represented). Collar septum with numerous irregular, roundish pores.

*Dimensions.*—Cephalis 0·04 diameter, thorax 0·1 long, 0·2 broad.

*Habitat.*—Central Pacific, Station 270 to 274, surface.

### 6. *Arachnocorys arachnodiscus*, n. sp.

Cephalis small, campanulate, conical, with a single very large conical central horn, and numerous smaller accessory spines. Thorax in form and structure similar to that of the three preceding species, but much flatter, being nearly discoidal. The meshes of the network are smaller and more numerous, irregularly polygonal, and the nine basal holes little larger. Collar septum with four large meshes (as in Pl. **60**, fig. 6).

*Dimensions.*—Cephalis 0·25 long, 0·3 broad; thorax 0·04 long, 0·24 broad.

*Habitat.*—North Pacific, Station 248, surface.

### 7. *Arachnocorys trifida*, n. sp.

Cephalis large, campanulate, with irregular, roundish pores and numerous ramified spines; in the centre of the top a larger pyramidal oblique horn of twice the length. Thorax cap-shaped, flatly vaulted, with nine strong convex ribs, prolonged into slender free feet. Three of these nine ribs are the centrifugal prolongations of the three cortinar bars (united in the centre of the collar stricture, separating its three large cortinar meshes); the other six are diverging lateral branches of the former, arising in pairs at both sides of its base. All nine ribs are connected by delicate arachnoidal network with irregular polygonal meshes. From its surface arise thin bristles, and from the base of each main rib a stout, perpendicular branch. All these dorsal spines are connected by irregular, arachnoidal wicker-work, covering thorax and cephalis. (A remarkable primitive species ?)

*Dimensions.*—Cephalis 0·05 long, 0·06 broad; thorax 0·07 long, 0·18 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Subgenus 3. *Arachnocorythium*, Haeckel.

*Definition.*—Thorax with a variable number of radial ribs (twelve to twenty or more), prolonged into free terminal feet.

### 8. *Arachnocorys polyptera*, n. sp.

Cephalis large, subspherical, with irregular, roundish pores and numerous radial spines. Thorax flatly conical, with numerous radial ribs (twenty to thirty), which are in the distal half free, in the proximal half connected by delicate arachnoidal wicker-work, with polygonal, irregular meshes. From its dorsal face arise numerous radial spines, which are connected together, and with the cephalic spines, by very thin and numerous threads, parallel between every two spines. Similar to

*Arachnocorys arancosa* (Pl. **56**, fig. 11), but differing in the structure of the cephalis, and in the greater number of the ribs and spines.

*Dimensions.*—Cephalis 0·04 diameter, thorax 0·12 long, 0·24 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

## Genus 565. *Anthocyrtoma*,[1] n. gen.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) without thoracic ribs, with six terminal feet around the mouth. Cephalis free, with an apical horn.

The genus *Anthocyrtoma* and the four following genera form together the peculiar group of Carpocanida, comprising all those Sethophormida in which the original thoracic ribs are lost, and only the terminal feet remain. *Anthocyrtoma* is the simplest form of this group, possessing only six terminal feet, three primary perradial, and three alternating, secondary, interradial. It may be directly derived either from *Lychnocanium*, by interpolation of three interradial feet, or from *Hexaspyris* by loss of the sagittal ring.

### 1. *Anthocyrtoma serrulata*, Haeckel.

*Anthocyrtis serrulata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. vi. fig. 7.

Shell pear-shaped, rough, with obliterated collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 3. Cephalis ovate, with very small pores, and a stout conical horn of the same length. Abdomen inflated, truncate, with larger, regular, circular pores, twice as broad as the constricted mouth. Six feet vertical, parallel, serrate, all of the same size, about as long as the cephalis.

*Dimensions.*—Cephalis 0·06 long, 0·05 broad; thorax 0·2 long, 0·17 broad.

*Habitat*—Fossil in Barbados.

### 2. *Anthocyrtoma alterna*, n. sp.

Shell pear-shaped, smooth, with distinct collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 6. Cephalis hemispherical, with a slender conical horn of twice the length. Abdomen inflated, subglobular, with regular, circular, hexagonally framed pores, three times as broad as the narrow, constricted mouth. Six feet conical, smooth, somewhat divergent, alternating, of different sizes; the three larger (perradial) half as long as the shell, and twice as long as the three smaller (interradial). (Similar to *Anthocyrtis ventricosa*.)

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·15 long, 0·18 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

[1] *Anthocyrtoma* = Flower-arch; ἄνθος, κύρτωμα.

Genus 566. *Anthocyrtis*,[1] Ehrenberg, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1847, p. 54.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) without thoracic ribs, with nine terminal feet around the mouth. Cephalis free, with an apical horn.

The genus *Anthocyrtis* (in the original definition of Ehrenberg) contained all Dicyrtida without thoracic ribs, with terminal feet. We here restrict the definition to those Sethophormida in which the number of free terminal feet is constantly nine (three primary perradial and three alternate pairs of secondary interradial feet). *Anthocyrtis* may be derived either directly from *Patagospyris* by loss of the sagittal ring, or from *Lychnocanium* by interpolation of three secondary feet.

Subgenus 1. *Anthocyrtella*, Haeckel.

*Definition.*—Feet of the peristome-corona divergent, their basal distance less than their terminal distance.

1. *Anthocyrtis mespilus*, Ehrenberg.

*Anthocyrtis mespilus*, Ehrenberg, 1854, Taf. xxxvi. fig. 13; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 66, Taf. vi. fig. 4 (not 5).

Shell smooth, with distinct collar stricture. Length of the two joints = 1 : 5, breadth = 2 : 6. Cephalis hemispherical, with a stout pyramidal horn of twice the length. Thorax nearly hemispherical, with regular, circular, quincuncial pores. Mouth scarcely constricted, with nine divergent, triangular, lamellar feet, about as long as the thorax.

*Dimensions.*—Cephalis 0·012 long, 0·02 broad; thorax 0·05 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

2. *Anthocyrtis furcata*, Ehrenberg.

*Anthocyrtis furcata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 64, Taf. vi. fig. 2.

Shell smooth, with deep collar stricture. Length of the two joints = 1 : 5, breadth = 2 : 6. Cephalis hemispherical, with a short pyramidal horn of half the length. Thorax hemispherical, with large, irregular, roundish pores. Mouth scarcely constricted, with nine divergent, curved, slender feet, which are about as long as the shell, and forked at the distal end.

*Dimensions.*—Cephalis 0·01 long, 0·02 broad; thorax 0·05 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

[1] *Anthocyrtis* = Flower-basket; ἄνθος, κυρτίς.

3. *Anthocyrtis butomus*, n. sp.

Shell thorny, with obliterated collar stricture. Length of the two joints = 2 : 6, breadth = 2 : 7. Cephalis ovate, with very small and scarce pores, and a conical horn of the same length. Thorax inflated, pear-shaped, with regular, circular, quincuncial pores. Mouth about half as broad, constricted, with nine divergent, broad, nearly square, lamellar feet, half as long as the thorax (similar to *Anthocyrtis serrulata*, Ehrenberg, *loc. cit.*, Taf. vi. fig. 7).

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·12 long, 0·14 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

4. *Anthocyrtis ventricosa*, Ehrenberg.

*Anthocyrtis ventricosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. viii. fig. 1.

Shell thorny, with obliterated collar stricture. Length of the two joints = 1 : 7, breadth = 2 : 7. Cephalis hemispherical, hyaline, without pores, with a slender, conical horn, of about the same length. Thorax inflated, pear-shaped or subspherical, with regular, circular, quincuncial pores. Mouth only one-third as broad, much constricted, with nine divergent, slender, conical feet, about one-fifth as long as the diameter of the shell (partly broken off in Ehrenberg's figure).

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·14 long, 0·14 broad.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms; also fossil in Barbados.

## Subgenus 2. *Anthocyrtissa*, Haeckel.

*Definition.*—Feet of the peristome-corona parallel, vertical; their basal and terminal distances equal.

5. *Anthocyrtis ophirensis*, Ehrenberg.

*Anthocyrtis ophirensis*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 285, Taf. ix. fig. 13.

Shell smooth, with slight collar stricture. Length of the two joints = 2 : 4, breadth = 1 : 5. Cephalis ovate, with irregular, roundish pores, and a pyramidal, excentric, vertical horn of the same length. Thorax campanulate, with delicate network of large, regular, hexagonal pores. Mouth scarcely constricted, with nine parallel, vertical, conical feet, about as long as the cephalis. (In the specimen figured by Ehrenberg only seven feet are represented, two being broken off; two other specimens of this species, captured by Rabbe, exhibited nine regularly disposed feet.)

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax 0·08 long, 0·1 broad.

*Habitat.*—Indian Ocean, Zanzibar (Pullen); Madagascar (Rabbe), surface.

6. *Anthocyrtis lauranthus*, n. sp.

Shell smooth, with slight collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 4. Cephalis ovate, with large, roundish pores, and a conical horn of twice the length. Thorax inflated, campanulate, with regular, circular, hexagonally framed pores. Mouth two-thirds as broad, little constricted, with nine parallel, vertical, broad, lamellar, triangular feet, half as long as the cephalis.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·1 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 266 to 270, depth 2550 to 2925 fathoms.

7. *Anthocyrtis grossularia*, Ehrenberg.

*Anthocyrtis grossularia*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 64, Taf. vi. fig. 6.

Shell spiny, with deep collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 4. Cephalis subspherical, thorny, with a conical horn of the same length. Thorax ovate, spiny, with numerous densely-crowded, subregular, circular pores. Mouth about half as broad, constricted, with nine parallel, vertical, slender, conical feet, about as long as the cephalis.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·2 long, 0·18 broad.

*Habitat.*—Fossil in Barbados.

8. *Anthocyrtis subglobosa*, n. sp.

Shell spiny, with deep collar stricture. Length of the two joints = 1 : 7, breadth = 1 : 7. Cephalis subspherical, with a conical horn twice the length. Thorax nearly spherical, with small and very numerous, regular, circular pores. Mouth only one-third as broad, constricted, with nine parallel, vertical, square, lamellar feet, about twice as long as the cephalis.

*Dimensions.*—Cephalis 0·03 long, 0·035 broad; thorax 0·2 long, 0·2 broad.

*Habitat.*—South Pacific, Station 297, depth 1775 fathoms.

## Subgenus 3. *Anthocyrtura*, Haeckel.

*Definition.*—Feet of the peristome-corona convergent, their basal distance greater than their terminal distance.

9. *Anthocyrtis enneaphylla*, n. sp.

Shell smooth, with sharp collar stricture. Length of the two joints = 1 : 6, breadth = 1 : 5. Cephalis subspherical, with a conical horn twice the length, nearly hyaline, with very small and scarce pores. Thorax nearly spherical, with regular, circular, quincuncial pores. Mouth only

half as broad, with nine broad, triangular feet, twice as long as the cephalis, and curved inwards, convergent towards the main axis.

*Dimensions.*—Cephalis 0·02 long, 0·025 broad; thorax 0·11 long, 0·12 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

10. *Anthocyrtis ovata*, n. sp. (Pl. 62, fig. 13).

Shell smooth, with slight collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 3. Cephalis ovate, with numerous small pores, and an excentric conical horn of the same length. Thorax ovate, with regular, circular, quincuncial pores. Mouth nearly of the same breadth, scarcely constricted, with nine triangular, widely-separated feet, about as long as the cephalis, and convergent towards the main axis.

*Dimensions.*—Cephalis 0·035 long, 0·03 broad; thorax 0·15 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Genus 567. *Anthocyrtium*,[1] n. gen.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) without thoracic ribs, with numerous terminal feet around the mouth (twelve to fifteen or more). Cephalis free, with an apical horn.

The genus *Anthocyrtium* has been derived from the two preceding genera by further multiplication of the terminal feet, the number of which is at least twelve to fifteen, often twenty or more. It may be that some species have arisen directly from *Patagospyris* by loss of the sagittal ring.

### Subgenus 1. *Anthocyrtarium*, Haeckel.

*Definition.*—Feet of the peristome-corona divergent, their basal distance less than their terminal distance.

1. *Anthocyrtium chrysanthemum*, n. sp. (Pl. 62, fig. 14).

Shell smooth, with distinct collar stricture. Length of the two joints = 3 : 7, breadth = 4 : 9. Cephalis hemispherical, with small, circular pores, and a large, straight, cylindro-conical horn, about as long as the shell. Thorax campanulate, hemispherical, with six to eight transverse rows of squarish pores, increasing in size downwards. Mouth little constricted, with twelve to fifteen divergent, curved, slender feet, about as long as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·07 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 270 to 274, depth 2350 to 2925 fathoms.

[1] *Anthocyrtium* = Flower-basket; ἄνθος, κύρτιον.

2. *Anthocyrtium centaurea*, Haeckel.

*Anthocyrtis mespilus*, var. *major*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. vi. fig. 5.

Shell smooth, with sharp collar stricture. Length of the two joints = 2 : 6, breadth = 3 : 7. Cephalis hemispherical, with irregular, roundish pores, and a very large pyramidal horn, longer than the shell, with contorted edges. Thorax hemispherical, with six to eight transverse rows of regular, circular pores of equal size. Mouth little constricted, with fifteen to twenty divergent, curved, slender feet, about as long as the shell.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·06 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

3. *Anthocyrtium anthemis*, n. sp.

Shell papillate, with obliterated collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis hemispherical, with very small and scarce pores, and a conical horn of the same length. Thorax conical, as long as broad, with conical papillæ, and eight to ten transverse rows of roundish pores, gradually increasing in size downwards. Mouth scarcely constricted, with fifteen to twenty divergent, straight, conical feet, half as long as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·09 long, 0·09 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

4. *Anthocyrtium collare*, Haeckel.

*Anthocyrtis collaris*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 64, Taf. vi. fig. 8.

Shell rough, conical, with obliterated collar stricture. Length of the two joints = 3 : 5, breadth = 4 : 7. Cephalis conical, with a pyramidal horn of the same length, and with two transverse rows of rather oblong, narrow pores. Thorax truncate, conical, in the lower part thorny, with six to eight transverse rows of regular, circular pores, increasing in size downwards.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·05 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

5. *Anthocyrtium adonis*, n. sp. (Pl. 62 fig. 20).

Shell rough, with sharp collar stricture. Length of the two joints = 3 : 10, breadth = 4 : 12. Cephalis subspherical, with very small circular pores, and a very long, straight cylindrical, horn, twice to three times as long as the shell. Thorax inflated, ovate, or subspherical, with small regular, circular, hexagonally-framed pores. Mouth strongly constricted, half as broad as the thorax, with fifteen to

twenty divergent, broad, lamellar, rectangular feet, as long as the thorax, and so densely placed that their margins come in contact with one another.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·1 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 263 to 268, depth 2650 to 3000 fathoms.

### 6. *Anthocyrtium anemone*, n. sp.

Shell spiny, with sharp collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 4. Cephalis subspherical, with a conical horn of half the length, hyaline, without pores. Thorax spiny, pear-shaped, inflated, with small and numerous, regular, circular pores. Mouth constricted, half as broad as the thorax, with twelve to fifteen divergent, slender, conical, denticulate feet, half as long as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·14 long, 0·12 broad.

*Habitat.*—Tropical Atlantic, Station, 347, depth 2250 fathoms; also fossil in Barbados.

## Subgenus 2. *Anthocyrtonium*, Haeckel.

*Definition.*—Feet of the peristome-corona parallel, vertical; their basal and apical distances equal.

### 7. *Anthocyrtium campanula*, n. sp. (Pl. 62, fig. 17).

Shell smooth, with deep collar stricture. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis spherical, with a conical horn of the same length. Thorax campanulate, thin-walled, with delicate network of regular, hexagonal pores and thin bars. Mouth little constricted, with twenty to twenty-four parallel, vertical, lanceolate feet, about as long as the cephalis.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·09 long, 0·1 broad.

*Habitat.*—South Pacific, Station 302, depth 1450 fathoms.

### 8. *Anthocyrtium reticulatum*, Haeckel.

*Thyrsocyrtis reticulata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 10.

Shell rough, with sharp collar stricture. Length of the two joints = 1 : 2, breadth = 1 : 3. Cephalis hemispherical, with a prismatic, denticulate horn of the same length, and small, irregular pores. Thorax campanulate, thorny, thin-walled, with delicate network of irregular, polygonal pores. Mouth little constricted, with twelve (or more) small, parallel, vertical, triangular feet, shorter than the cephalis.

*Dimensions.*—Cephalis 0·015 long, 0·02 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

9. *Anthocyrtium leptostylum*, Haeckel.

*Anthocyrtis leptostyla*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 64, Taf. vi. fig. 1.

Shell thorny, with slight collar stricture. Length of the two joints = 1 : 5, breadth = 2 : 4. Cephalis hemispherical, with small, scarce pores and a slender conical horn of the same length. Thorax spiny, with regular, circular, quincuncial pores. Mouth constricted, half as broad, with twelve to eighteen slender, parallel, vertical feet, about as long as the cephalis.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·1 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 266 to 270, depth 2550 to 2925 fathoms; also fossil in Barbados.

10. *Anthocyrtium hispidum*, Haeckel.

*Anthocyrtis hispida*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 64, Taf. viii. fig. 2.

*Anthocyrtis hispida*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 540, Taf. xxxiii. fig. 30.

Shell thorny, with sharp collar stricture. Length of the two joints = 1 : 4, breadth = 2 : 5. Cephalis hemispherical, hyaline, with few very small pores, or without any; with a stout conical horn of twice the length. Thorax spiny, with regular, circular, hexagonally-framed pores (half as broad as the bars between them). Mouth wide open, scarcely constricted, with twelve to fifteen parallel, vertical, broad, lamellar, rectangular feet, reaching nearly the length of the thorax.

*Dimensions.*—Cephalis 0·02 to 0·03 long, 0·03 to 0·05 broad; thorax 0·07 to 0·09 long, 0·1 to 0·12 broad.

*Habitat.*—Central Pacific, Stations 263 to 265, depth 2650 to 3000 fathoms; also fossil in Barbados.

11. *Anthocyrtium turris*, n. sp.

Shell thorny, very similar to *Calocyclas turris*, Ehrenberg (1875, *loc. cit.*, Taf. xviii. fig. 7), but without fenestrated abdomen. Collar stricture deep. Length of the two joints = 1 : 3, breadth = 1 : 3. Cephalis subspherical, hyaline, without pores, with a stout conical horn of twice the length. Thorax nearly spherical, spiny, with regular, circular, quincuncial pores. Mouth little constricted, with fifteen to twenty parallel, vertical, broad, lamellar, rectangular feet, about as long as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·1 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

12. *Anthocyrtium doronicum*, n. sp. (Pl. 62, fig. 18).

Shell rough, with sharp collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 3. Cephalis hemispherical, with small, circular pores and a stout conical horn of twice the length. Thorax campanulate, subcylindrical, with regular, circular, quincuncial pores, three to four times as broad as the bars. Mouth scarcely constricted, with twenty-four to thirty vertical, nearly parallel, little curved feet, which are about half as long as the shell, broad, lamellar, rectangular, and in close contact with their edges.

*Dimensions*—Cephalis 0·025 long, 0·035 broad; thorax 0·12 long, 0·1 broad.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

## Subgenus 3. *Anthocyrturium*, Haeckel.

*Definition.*—Feet of the peristome-corona convergent, their basal distance greater than their apical distance.

13. *Anthocyrtium pyrum*, n. sp. (Pl. 62, fig. 12).

Shell smooth, with obliterated collar stricture. Length of the two joints = 2 : 7, breadth = 3 : 8. Cephalis hemispherical, with a small, bristle-shaped horn of half the length. Thorax inflated, subglobose, with regular, circular, quincuncial pores and thin bars. Mouth constricted, only half as broad, with fifteen to twenty small, triangular, convergent feet, shorter than the cephalis. (In another specimen the feet were twice as long, stronger and more convergent, than in the one figured.)

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·07 long, 0·8 broad.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

14. *Anthocyrtium setosum*, Haeckel.

*Anthocyrtis setosa*, Haeckel, 1862, Monogr. d. Radiol., p. 311.
? *Lithopera setosa*, Ehrenberg, 1854, Mikrogeol., Taf. xxxv. B., B. iv. fig. 23.

Shell spiny, with sharp collar stricture. Length of the two joints = 1 : 2, breadth = 1 : 3. Cephalis hemispherical, with a conical horn of the same length and some accessory spines. Thorax campanulate, with subregular, circular pores. Mouth little constricted, with twenty to thirty small, triangular, convergent feet, about as long as the cephalis. (In Ehrenberg's incomplete figure they are mostly broken off.)

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

15. *Anthocyrtium ehrenbergii*, Haeckel.

*Anthocyrtis ehrenbergii*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 100, Taf. iii. fig. 21, *a*, *b*.

Shell smooth, with obliterated collar stricture. Length of the two joints = 3 : 10. breadth = 2 : 8. Cephalis subcylindrical, with an excentric, stout, pyramidal horn of the same length. Thorax bottle-shaped, with small, regular, circular pores of equal size. Mouth little constricted, with twenty to thirty small, triangular, convergent feet, about half as long as the cephalis.

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax 0·1 long, 0·08 broad.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte), Stöhr.

16. *Anthocyrtium zanguebaricum*, Haeckel.

*Anthocyrtis zanguebarica*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 285, Taf. ix. fig. 12.

Shell smooth, with slight collar stricture. Length of the two joints = 3 : 10, breadth = 2 : 7. Cephalis subspherical, with an excentric conical horn of the same length. Thorax slender, ovate or bottle-shaped, with irregular, roundish pores increasing in size downwards. Mouth little constricted, with twelve to fifteen small, triangular, convergent feet, about half as long as the cephalis.

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax 0·1 long, 0·07 broad.

*Habitat.*—Indian Ocean (Zanzibar), depth 2200 fathoms, Pullen.

17. *Anthocyrtium ficus*, Haeckel.

*Anthocyrtis ficus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 64, Taf. vi. fig. 3.

Shell rough, with obliterated collar stricture. Length of the two joints = 2 : 12, breadth = 3 : 10. Cephalis conical, with a large, cylindrical horn, pyramidal at the base, about as long as the thorax. Thorax subovate, truncate, papillate, with small, regular, circular, quincuncial pores of the same breadth as the bars. Mouth constricted, two-thirds as broad as the thorax, with fifteen to twenty strongly convergent, lamellar, rectangular or sword-shaped feet, nearly as long as the thorax.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·12 long, 0·1 broad.

*Habitat.*—Fossil in Barbados.

18. *Anthocyrtium flosculus*, n. sp. (Pl. 62, fig. 19).

*Anthocyrtis flosculus*, Haeckel, 1881, Prodromus et Atlas, pl. lxii. fig. 19.

Shell ribbed, with distinct collar stricture. Length of the two joints = 1 : 4, breadth = 2 : 4. Cephalis hemispherical, with small, circular pores and a large cylindrical horn, twice as long as the thorax and half as broad at the base as the cephalis. Thorax subovate, truncate, with twenty-four to thirty longitudinal ribs and alternating rows of circular pores. Mouth constricted, two-thirds

as broad as the thorax, with twenty-four to thirty slender, convergent feet, which are as long as the entire shell, with their edges in close contact and their distal ends pointed.

*Dimensions.*—Cephalis 0·03 long, 0·05 broad; thorax 0·12 long, 0·12 broad.

*Habitat.*—Central Pacific, Stations 265 to 274, depth 2350 to 2925 fathoms.

## Genus 568. *Anthocyrtidium*,[1] Haeckel, 1881, Prodromus, p. 431.

*Definition.*—Sethophormida, (vel Dicyrtida multiradiata aperta) without thoracic ribs, with numerous (twelve to fifteen or more) subterminal feet, which are separated from the constricted mouth by a ring of lattice-work. Cephalis free, with an apical horn.

The genus *Anthocyrtidium* has been derived from the preceding *Anthocyrtium* by further growth and constriction of the peristome, which becomes separated from the subterminal corona of feet by a more or less broad ring of lattice-work.

### 1. *Anthocyrtidium cineraria*, n. sp. (Pl. 62, fig. 16).

Shell campanulate, smooth, with obliterated collar stricture. Length of the two joints = 5 : 11, breadth = 3 : 13. Cephalis subcylindrical-ovate, with a conical straight horn of half the length. Thorax hemispherical, inflated, nearly twice as broad as the constricted mouth. Pores subregular, circular, double-contoured. Above the mouth, separated from it by two rows of pores, a corona of twelve to fifteen short conical feet, which are directed downwards, slightly curved, and as long as the cephalic horn.

*Dimensions.*—Cephalis 0·05 long, 0·03 broad; thorax 0·11 long, 0·13 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 2. *Anthocyrtidium ligularia*, n. sp. (Pl. 62, fig. 15).

Shell campanulate, rough, with distinct collar stricture. Length of the two joints = 1 : 4, breadth = 2 : 6. Cephalis hemispherical, with a slender, conical, slightly curved horn, about as long as the shell. Thorax hemispherical, three times as broad as the cephalis, nearly twice as broad as the constricted mouth, which is prolonged into a prominent smooth ring. Above the mouth, separated from it by one row of pores, a corona of twelve to fifteen slender linear feet, which are slightly curved, divergent, and emarginate at the truncated distal end.

*Dimensions.*—Cephalis 0·015 long, 0·03 broad; thorax 0·06 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

[1] *Anthocyrtidium* = Small flower-basket; ἄνθος, κυρτίδιον.

3. *Anthocyrtidium matricaria*, n. sp.

Shell campanulate, rough, very similar to the preceding species, but differing in the straight, large, pyramidal horn of the cephalis (as long as the shell), and in the longer feet, which are twelve to fifteen in number, little curved at the distal end, pointed, and about as long as the shell. Length of the two joints = 2 : 6, breadth = 3 : 8. Differs from the similar *Anthocyrtium centaurea*, Ehrenberg (1875, *loc. cit.*, Taf. vi. fig. 5), mainly in the prominent ring of the peristome.

*Dimensions.*—Cephalis, 0·02 long, 0·03 broad; thorax 0·06 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

Genus 569. *Carpocanium*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Sethophormida (vel Dicyrtida multiradiata aperta) without thoracic ribs, with numerous terminal feet around the mouth (six to twelve or more). Cephalis hidden in the thorax, without apical horn.

The genus *Carpocanium*, very common, and rich in numerous living and fossil species, was formerly placed by me among the true Monocyrtida, since an external constriction is not visible (Monogr., 1862, p. 290). Afterwards (in 1879) Richard Hertwig demonstrated that the cavity of the ovate shell, externally simple, is divided by an internal transverse septum into two joints, the upper of which is the flat rudimentary cephalis (Organism. d. Radiol., p. 79; compare also Bütschli, 1882, *loc. cit.*, p. 535). Indeed this septum, with four central crossed cortinar beams, is a true collar septum, and *Carpocanium* has been derived from *Anthocyrtis* or *Desmospyris* by reduction of the cephalis, which is very flat and perfectly hidden in the uppermost part of the thorax. The apical horn is lost. If the internal septum were to become lost, the genus would pass over into *Carpocanistrum*.

Subgenus 1. *Carpocanarium*, Haeckel.

*Definition.*—Peristome-corona composed of six feet (three primary perradial alternating with three secondary interradial).

1. *Carpocanium calycodes*, Stöhr.

*Carpocanium calycodes*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 96, Taf. iii. fig. 8.

Shell urceolate, smooth, nearly twice as long as broad, with hemispherical vaulted cephalis. Length of the two joints = 3 : 16, breadth = 5 : 10. Pores regular, circular, as broad as the bars,

[1] *Carpocanium* = Fruit-basket; καρπός, κάνεον.

quincuncially disposed in about five longitudinal series at each side. Mouth constricted, half as broad as the thorax. Peristome with six vertical, equilateral, triangular feet.

*Dimensions.*—Cephalis 0·015 long, 0·025 broad; thorax 0·08 long, 0·05 broad.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte, Caltanisetta).

2. *Carpocanium setosum*, Haeckel.

*Halicalyptra setosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 160, Taf. ii. fig. 12.

Shell ovate, truncate at the mouth, thorny, exactly as long as broad. Length of the two joints = 1 : 8, breadth = 3 : 9. Cephalis hidden, with very small pores. Thorax inflated, with regular, circular pores, twice as broad as the bars, in about ten longitudinal series at each side. Mouth constricted, half as broad as the thorax. Peristome with six vertical, parallel, broad, lamellar, rectangular feet, separated by equal intervals, half as long as the shell.

*Dimensions.*—Cephalis 0·01 long, 0·03 broad; thorax 0·08 long, 0·09 broad.

*Habitat.*—Fossil in Barbados.

3. *Carpocanium laeve*, Ehrenberg.

*Carpocanium laeve*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287.

Shell subspherical, smooth, equal in length and breadth, with little vaulted, cap-shaped cephalis. Length of the two joints = 1 : 6, breadth = 4 : 7. Pores regular, circular, twice as broad as the bars, in nine longitudinal rows. Mouth constricted, only one-third as broad as the thorax. Peristome with six strong conical feet, which are slightly curved and convergent.

*Dimensions.*—Cephalis 0·01 long, 0·04 broad; thorax 0·06 long, 0·07 broad.

*Habitat.*—Mediterranean (Greece); Tropical Atlantic, Station 348, depth 2450 fathoms.

4. *Carpocanium lanceolatum*, n. sp.

Shell subspherical, thorny, with perfectly hidden cephalis. Length of the two joints = 1 : 3, breadth = 1 : 3. Pores regular, circular, hexagonally framed, half as broad as the bars, in about sixteen longitudinal rows at each side. Mouth constricted, half as broad as the thorax. Peristome with six large lanceolate, vertical, lamellar feet, half as long as the shell.

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·09 long, 0·09 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

Subgenus 2. *Carpocanidium*, Haeckel.

*Definition.*—Peristome-corona composed of nine feet (three primary perradial and six secondary interradial).

5. *Carpocanium diadema*, Haeckel.

*Carpocanium diadema*, Haeckel, 1862, Monogr. d. Radiol, p. 290, Taf. v. fig. 1.
*Carpocanium diadema*, R. Hertwig, 1879, Organism. d. Radiol., p. 79, Taf. viii. figs. 7, 7*a*, 8, 8*a*, 8*b*.

Shell ovate, with little vaulted cephalis. Length of the two joints = 1 : 8, breadth = 3 : 6. Pores regular, circular, in about twelve longitudinal rows, twice as broad as the bars. Mouth constricted, half as broad as the thorax. Peristome with nine vertical, equilateral, triangular feet.

*Dimensions.*—Cephalis 0·01 long, 0·03 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific; many stations, surface.

6. *Carpocanium cylindricum*, n. sp.

Shell cylindrical, with hemispherical, flatly vaulted cephalis. Length of the two joints = 1 : 4, breadth = 3 : 3. Pores regular, circular, double-contoured, as broad as the bars, in about fifteen longitudinal series. Mouth constricted, two-thirds as broad as the thorax. Peristome with nine vertical, slender, triangular, pointed feet.

*Dimensions.*—Cephalis 0·02 long, 0·06 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

7. *Carpocanium enneaphyllum*, n. sp.

Shell slenderly ovate, at the mouth truncate, thorny, with hemispherical, vaulted cephalis. Length of the two joints = 1 : 6, breadth = 2 : 4. Pores regular, circular, hexagonally framed, as broad as the bars, in about thirteen longitudinal rows. Mouth constricted, about two-thirds as broad as the thorax. Peristome with nine broad, lamellar, vertical, nearly square feet, half as long as the shell, with small intervals.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·12 long, 0·09 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

8. *Carpocanium solitarium*, Ehrenberg.

*Carpocanium solitarium*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 28.
*Lithocampe solitaria*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 65.

Shell slenderly ovate, twice as long as broad, with hidden spherical cephalis, completely enclosed in the summit of the thorax. Length of the two joints = 1 : 6, breadth = 1 : 4. Pores small, regular, circular, as broad as the bars, in about eleven longitudinal rows. Mouth gradually constricted, half as broad as the thorax. Peristome with nine ovate blunt feet, which are as long as the cephalis, little curved and convergent.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·12 long, 0·07 broad.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Caltanisetta).

9. *Carpocanium gemmula*, n. sp.

Shell subspherical, smooth, equal in length and breadth, with hemispherical vaulted cephalis. Length of the two joints = 2 : 7, breadth = 4 : 9. Pores small, regular, circular, twice as broad as the bars, in about twenty longitudinal rows. Mouth strongly constricted, only one-fourth as broad as the thorax. Peristome with nine conical feet, which are twice as long as the cephalis, curved, and so convergent that their distal ends come nearly in contact.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·07 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

10. *Carpocanium microdon*, Ehrenberg.

*Carpocanium microdon*, Ehrenberg, 1858, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 30.

Shell broad, ovate, rough, with perfectly hidden cephalis. Length of the two joints = 2 : 9, breadth = 4 : 7. Pores very small and scarce, smaller than the bars between them, irregularly scattered. Mouth constricted, one-third as broad as the thorax. Peristome with nine short, triangular, pointed, convergent feet.

*Dimensions.*—Cephalis 0·02 long. 0·04 broad; thorax 0·09 long, 0·07 broad.

*Habitat.*—Mediterranean (Crete), Atlantic (Canary Islands), Station 354, surface.

## Subgenus 3. *Carpocanobium*, Haeckel.

*Definition.*—Peristome-corona composed of twelve or more feet.

11. *Carpocanium trepanium*, n. sp. (Pl. 52, fig. 18).

Shell subcylindrical, with flatly vaulted cephalis. Length of the two joints = 1 : 6, breadth = 3 : 4. Pores regular, hexagonal, four to six times as broad as the bars. Mouth little constricted, two-thirds as broad as the thorax. Peristome with eighteen to twenty-four large, slender, triangular, vertical feet.

*Dimensions.*—Cephalis 0·02 long, 0·06 broad; thorax 0·12 long, 0·08 broad.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

12. *Carpocanium hexagonale*, n. sp. (Pl. 52, fig. 15).

Shell broadly ovate or subconical, with vaulted, cap-shaped cephalis. Length of the two joints = 2 : 7, breadth = 5 : 9. Thorax subglobular, truncate. Pores subregular, hexagonal, three to four times as broad as the bars. Mouth constricted, two-thirds as broad as the thorax. Peristome with twenty to twenty-five small, triangular, vertical feet.

*Dimensions.*—Cephalis 0·02 long, 0·05 broad; thorax 0·07 long, 0·09 broad.

*Habitat.*—Tropical Atlantic, Station 347, surface.

13. *Carpocanium petalospyris*, n. sp. (Pl. 52, fig. 19).

Shell subspherical, smooth, with perfectly hidden cephalis. Length of the two joints = 1 : 6, breadth = 3 : 6. Pores regular, circular, hexagonally framed, twice as broad as the bars, in about sixteen longitudinal rows. Mouth slightly constricted, little narrower than the thorax. Peristome with twenty to twenty-four vertical, broad, lamellar feet, which are nearly as long as the shell, at the distal end truncate, and almost in contact at their edges.

*Dimensions.*—Cephalis 0·02 long, 0·05 broad; thorax 0·11 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

14. *Carpocanium polypterum*, Haeckel.

*Cryptoprora polyptera*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. ix. fig. 17.

*Carpocanium macropterum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 302.

Shell campanulate-conical, smooth, with perfectly hidden cephalis. Length of the two joints = 1 : 6, breadth = 4 : 6. Pores regular, circular, twice as broad as the bars, in about sixteen longitudinal rows. Mouth wide open, not constricted. Peristome with twenty to thirty vertical, slender, conical feet, about as long as the shell.

*Dimensions.*—Cephalis 0·01 long, 0·04 broad; thorax 0·06 long, 0·06 broad.

*Habitat.*—Indian Ocean (Zanzibar), depth 2200 fathoms (Pullen).

15. *Carpocanium palmipes*, n. sp.

Shell ovate, very thick-walled, smooth. Lower half of the subspherical cephalis hidden in the summit of the thorax, upper half free, with few small pores. Length of the two joints = 3 : 10, breadth = 3 : 10. Thorax foveolate, with oblong dimples, each of which encloses a small, circular, double-contoured pore, half as broad as the bars. Mouth little constricted, nearly as broad as the thorax. Peristome prolonged into a solid, cylindrical tube, nearly as long and as broad as the shell; the upper half of the tube is solid, the lower divided into from twelve to fifteen vertical, lamellar, pointed feet.

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·1 long, 0·1 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

16. *Carpocanium peristomium*, n. sp. (Pl. 52, figs. 16, 17).

Shell ovate, smooth, with perfectly hidden, flat cephalis (fig. 17). Length of the two joints = 2 : 10, breadth = 5 : 9. Pores small and very numerous, regular, circular, as broad as the bars, in about twenty longitudinal rows. Mouth little constricted. Peristome broad; in the upper

half a hyaline, circular ring, in the lower half divided into from eighteen to twenty-four triangular, curved, little convergent feet.

*Dimensions.*—Cephalis 0·02 long, 0·05 broad; thorax 0·1 long, 0·09 broad.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific; many stations, at various depths.

### 17. *Carpocanium coronatum*, Ehrenberg.

*Carpocanium coronatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. v. fig. 7.

Shell ovate, smooth, with perfectly hidden, subspherical cephalis. Length of the two joints = 2 : 9, breadth = 2 : 8. Pores small and very numerous, twice as broad as the bars, regular, circular, in about twenty longitudinal rows. Mouth little constricted, two-thirds as broad as the thorax. Peristome with twenty-five to thirty short, bristle-shaped feet, which are slightly curved, convergent, and in the upper half connected by a solid ring.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

### 18. *Carpocanium dactylus*, n. sp.

Shell slenderly ovate, twice as long as broad, with flat, perfectly hidden cephalis. Length of the two joints = 1 : 12, breadth = 4 : 8. Pores subregular, circular, as broad as the bars, in about twelve longitudinal rows, separated by prominent longitudinal ribs. Mouth constricted, two-thirds as broad as the thorax. Peristome with twelve large, lanceolate, lamellar, convergent feet.

*Dimensions.*—Cephalis 0·01 long, 0·04 broad; thorax 0·12 long, 0·08 broad.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

### 19. *Carpocanium irregulare*, n. sp. (Pl. 52, fig. 14).

Shell irregular, roundish, subovate, with flat and oblique, perfectly hidden cephalis. Length of the two joints = 1 : 10, breadth = 3 : 9. Pores irregularly scattered, roundish, about as broad as the bars. Mouth wide open, not at all or little constricted. Peristome with twenty to thirty long, lamellar, pointed feet, which are irregularly curved and convergent.

*Dimensions.*—Cephalis 0·01 to 0·02 long, 0·03 to 0·04 broad; thorax 0·09 to 0·11 long, 0·08 to 0·09 broad.

*Habitat.*—Central Pacific, Station 263 to 274, surface, and at various depths.

### 20. *Carpocanium verecundum*, n. sp. (Pl. 52, figs. 12, 13).

Shell ovate, smooth, with flat, perfectly hidden cephalis (fig. 12). Length of the two joints = 1 : 9, breadth = 4 : 9. Pores subregular, circular, twice as broad as the bars, in about eighteen,

partly interrupted, longitudinal rows, separated by prominent crests. Mouth little constricted. Peristome with twenty to twenty-four broad, lamellar, pointed feet, which are about as long as the shell, little curved, and convergent.

*Dimensions.*—Cephalis 0·01 long, 0·04 broad; thorax 0·09 long, 0·09 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

21. *Carpocanium virgineum*, n. sp. (Pl. 52, fig. 20).

Shell ovate, smooth, with flat, perfectly hidden cephalis. Length of the two joints = 1 : 8, breadth = 3 : 9. Pores regular, circular, hexagonally framed, as broad as the bars, in about sixteen longitudinal rows on each side. Mouth little constricted. Peristome with eighteen to twenty-four very large, lamellar, pointed feet, which are longer than the shell, and so curved and convergent that their distal points come nearly in contact.

*Dimensions.*—Cephalis 0·01 long, 0·03 broad; thorax 0·08 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Subfamily 2. SETHOPHÆNIDA, Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Anthocyrtida with the basal mouth of the shell fenestrated (vel Dicyrtida multiradiata clausa).

### Genus 570. *Sethophæna*,[1] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethophænida (vel Dicyrtida multiradiata clausa) with lateral apophyses. Cephalis with a horn.

The genus *Sethophæna* and the following *Clistophæna* form together the small subfamily of Sethophænida, comprising those Dicyrtida in which the thorax bears numerous radial appendages (four to six or more), and the mouth is closed by a lattice-plate. In *Sethophæna* the apophyses are lateral wings, as in *Micromelissa*, from which it may be derived by development of secondary wings, interpolated between the three primary wings.

1. *Sethophæna tetraptera*, n. sp.

Shell smooth, with deep collar stricture. Length of the two joints = 3 : 10, breadth = 4 : 9. Cephalis subspherical, without horn. Thorax ovate, with rounded hemispherical base, and subregular, hexagonal pores. From its upper half (below the collar stricture) arise four divergent,

[1] *Sethophæna* = Sieve-shell; σήθω, φαίνα.

conical, straight wings, of half the length, opposite in pairs in two meridional planes, perpendicular to one another (compare *Tetralacorys*, Pl. 65, figs. 4, 5).

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·1 long, 0·09 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

2. *Sethophæna hexaptera*, n. sp. (Pl. 97, fig. 13).

Shell rough, pear-shaped, with distinct collar stricture. Length of the two joints = 1 : 4, breadth = 2 : 4. Cephalis hemispherical, with a conical horn of the same length. Thorax inflate, inversely ovate, nearly pear-shaped, with subregular, circular pores. From its upper half arise, by a broad base, six divergent, strong, conical wings, which are horn-like, curved downwards, and half as long as the thorax.

*Dimensions.*—Cephalis 0·025 long, 0·04 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Sethophæna enneaptera*, n. sp.

Shell rough, with sharp collar stricture. Length of the two joints = 1 : 6, breadth = 1 : 3. Cephalis subspherical, with a stout conical horn of twice the length. Thorax inversely ovate, with pointed, conical, basal part, and irregular, roundish pores. From its middle part arise, by a broad triangular base, nine compressed, divergent wings, which are a little curved, slender, and about as long as the thorax.

*Dimensions.*—Cephalis 0·025 long, 0·03 broad; thorax 0·17 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Sethophæna polyptera*, n. sp.

Shell thorny, with slight collar stricture. Length of the two joints = 1 : 10, breadth = 3 : 8. Cephalis flat, cap-shaped, without horn. Thorax pear-shaped, with hemispherical base and regular, circular pores. From its lower half (beyond the equator) arises a corona of numerous short conical wings (eighteen to twenty-four), which are a little curved, and divergent downwards, scarcely one-third as long as the thorax.

*Dimensions.*—Cephalis 0·015 long, 0·04 broad; thorax 0·15 long, 0·12 broad.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

Genus 571. *Clistophæna*,[1] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethophænida (vel Dicyrtida multiradiata clausa) with terminal apophyses. Cephalis with a horn.

[1] *Clistophæna* = Closed shell; *σήθω*, *φαίνα*.

The genus *Clistophæna* agrees with the preceding *Sethophæna* in the mouth of the thorax being closed by a lattice-plate. But the appendages of the thorax are terminal feet, not lateral wings; their number is commonly six or nine, rarely more. *Clistophæna* may be derived either from *Tetrahedrina* by interpolation of secondary feet between the three primary, or from *Sethamphora* by development of a basal lattice-plate closing the mouth.

1. *Clistophæna rüstiana*, n. sp. (Pl. 57, fig. 6).

Shell rough, with distinct collar stricture. Length of the two joints = 3 : 10, breadth = 4 : 11. Cephalis hemispherical, with small, circular pores and a stout oblique horn three times the length, which is three-sided prismatic, and at the top denticulate. Thorax subconical, inflate, with regular, circular, quincuncial pores, increasing in size towards the base. Margin of the flat base, with six divergent, stout feet of the same prismatic form as the cephalic horn, with denticulate distal ends, about as long as the thorax. This elegant species is dedicated to Dr. Rüst of Freiburg, the discoverer of numerous fossil Radiolaria in the Liassic and Jurassic formations.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·1 long, 0·11 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Clistophæna hexolena*, n. sp.

Shell smooth, with slight collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 5. Cephalis subspherical, small, with a large, vertical, cylindrical horn, about as long as the shell, and small, circular pores. Thorax nearly three-sided pyramidal or tetrahedral, with three rounded edges and subregular, circular pores. Margin of the flat base with six conical, divergent, straight feet, somewhat shorter than the thorax. (Three on the corners, one on the middle of each side of the triangular base.)

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·12 long, 0·14 broad.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

3. *Clistophæna pyramidalis*, n. sp.

Shell smooth, with slight collar stricture. Length of the two joints = 2 : 8, breadth = 3 : 10. Cephalis hemispherical, with a stout pyramidal horn of twice the length. Thorax six-sided pyramidal, with regular, circular pores of equal size, and six prominent, straight edges, which are prolonged into six divergent, pyramidal feet of half the length.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·08 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

4. *Clistophæna armata*, n. sp. (Pl. 57, fig. 7).

Shell spiny, with deep collar stricture. Length of the two joints = 4 : 18, breadth = 5 : 15. Cephalis subspherical, with small, circular, hexagonally-framed pores, and a stout, three-sided prismatic, cuspidate horn of the same length. Thorax pear-shaped, with regular, circular pores and three pairs of stout pyramidal wings, placed in the three primary meridional planes of the collar beams; three of them lie in the upper, and three in the lower third of the thorax. Margin of the flat base with nine cylindrical, somewhat club-shaped, divergent feet.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·18 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

5. *Clistophæna enneolena*, n. sp.

Shell spiny, with sharp collar stricture. Length of the two joints = 4 : 20, breadth 5 : 16. Cephalis hemispherical, hyaline, with a stout conical horn of the same length and some small accessory horns. Thorax ovate, spiny, with subregular, circular pores. Margin of the vaulted base with nine divergent, conical feet, half as long as the thorax.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·2 long, 0·16 broad.

*Habitat.*—South Pacific, Station 296, depth 1825 fathoms.

6. *Clistophæna polyolena*, n. sp.

Shell smooth, conical, with obliterated collar stricture. Length of the two joints = 1 : 5, breadth = 2 : 5. Cephalis hemispherical, with small, circular pores and two divergent conical horns (a major occipital and a smaller frontal horn). Thorax obtusely conical, with regular, hexagonal pores at the mantle, and circular pores in the basal plate, the margin of which bears eighteen vertical, parallel, conical feet, as long as the cephalis.

*Dimensions.*—Cephalis 0·015 long, 0·025 broad; thorax 0·08 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

## Family LXIV.—Sethocyrtida, n. fam.

*Sethocorida et Sethocapsida*, Haeckel, 1881, Prodromus, pp. 439, 433.

*Definition.*—Dicyrtida eradiata. (Cyrtoidea with a two-jointed shell, divided by a transverse constriction into cephalis and thorax, without radial apophyses).

The family Sethocyrtida, composed of the Sethocorida and Sethocapsida of my Prodromus, comprises those Cyrtoidea in which the shell is two-jointed and bears no radial apophyses. The two subfamilies differ in the shape of the mouth, which in the Sethocorida is a simple wide opening, and in the Sethocapsida is closed by a lattice-plate. The former are here divided into eight, the latter into three genera.

Numerous living and fossil forms of Sethocyrtida were previously described by Ehrenberg, partly in his genera *Dictyocephalus* and *Lophophæna*, partly (intermingled with three-jointed and many-jointed forms) in the genera *Eucyrtidium* and *Lithocampe*. A larger number of new forms has been found in the Radiolarian ooze collected by the Challenger, and others fossil in Barbados. Many of these Sethocyrtida are common and widely distributed. When a new third joint is formed on their basal mouth, they pass over into Theocyrtida.

The cephalis is usually subspherical or hemispherical, and much smaller than the thorax, the form of which exhibits all possible intermediate stages between flat, discoidal, conical, cylindrical, and ovate forms. The wide open mouth becomes more and more constricted, and finally closed in the Sethocapsida. The majority of the Sethocyrtida may have been derived either from the Tripocyrtida, or from the Anthocyrtida by reduction and loss of the radial apophyses.

*Synopsis of the Genera of Sethocyrtida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Sethocorida. Terminal mouth of the thorax a simple wide opening | Thorax conical or campanulate, gradually dilated. | Shell simple, without mantle, | 572. | *Sethoconus.* |
| | | Shell double, with an arachnoidal mantle, | 573. | *Periarachnium.* |
| | Thorax discoidal, flatly expanded. | Cephalis very large, without horn, | 574. | *Sethocephalus.* |
| | Thorax cylindrical or ovate, with truncate, constricted or tubular mouth. | Cephalis with a single horn. Mouth simple, | 575. | *Sethocyrtis.* |
| | | Cephalis with a single horn. Mouth tubular, | 576. | *Sethocorys.* |
| | | Cephalis with two horns or a bunch of horns, | 577. | *Lophophæna.* |
| | | Cephalis without horn, | 578. | *Dictyocephalus.* |
| II. Subfamily Sethocapsida. Terminal mouth closed by a lattice-plate. | Cephalis free, not hidden in the thorax. | One horn, | 579. | *Sethocapsa.* |
| | | No horn, | 580. | *Dicolocapsa.* |
| | Cephalis hidden in the upper part of the thorax. | No horn, | 581. | *Cryptocapsa.* |

Subfamily 1. SETHOCORIDA, Haeckel, Prodromus, p. 430.

*Definition.*—Sethocyrtida with the basal mouth of the shell open (vel Dicyrtida eradiata aperta).

## Genus 572. *Sethoconus*,[1] Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Sethocorida (vel Dicyrtida eradiata aperta) with conical or campanulate, gradually dilated thorax and wide open mouth. Cephalis with one or more horns.

The genus *Sethoconus* is the oldest and simplest form of the Sethocorida, or of those Dicyrtida in which the simple thorax bears no apophyses and has the mouth open and not closed by a basal lattice-plate. Probably all those eradiate Sethocorida have been derived either from triradiate Sethopilida (*Lychnocanium*), or from multiradiate Sethophormida (*Sethophormis*, *Anthocyrtis* ?) by loss of the radial ribs and feet. In *Sethoconus* the thorax is more or less conical, sometimes more campanulate, commonly smooth, in some species covered with spines. The cephalis is usually small, with rudimentary collar septum, at other times large, with distinct cortinar septum. Correspondingly, the genus may be divided into different groups, which here are enumerated as subgenera.

### Subgenus 1. *Conarachnium*, Haeckel, 1881, Prodromus, p. 430 (= *Ceratocyrtis*, Bütschli), 1882, *loc. cit.*, p. 536.

*Definition.*—Cephalis relatively large, with distinct collar septum and numerous pores. Thorax smooth.

1. *Sethoconus trochus*, Haeckel.

*Eucyrtidium trochus*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 17.

*Conarachnium trochus*, Haeckel, 1881, Prodromus, p. 430.

Cephalis ovate, relatively large, with a pyramidal horn of the same length, and three pairs of large opposite pores, on each side of a vertical septum. Thorax wide, conical, about as long as broad, with nearly straight outlines; its pores regular, circular, hexagonally framed, of the same size as the cephalic pores.

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax 0·06 long, 0·06 broad.

*Habitat.*—Tropical Pacific, Stations 200 to 281, surface.

2. *Sethoconus cucullaris*, Haeckel.

*Cornutella cucullaris*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 7.

*Ceratocyrtis cucullaris*, Bütschli, 1882, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 536, Taf. xxxiii. fig. 36, *a. b.*

Cephalis subspherical, thorny, relatively large, with a conical horn of the same length, and small circular pores. Thorax wide, conical, enveloping the lower hidden half of the cephalis, about as

[1] *Sethoconus* = Sieve-cone ; σήθω, κῶνος.

long as broad, with slightly convex outlines; its pores subregular, circular, half as broad as the cephalis.

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax 0·15 long, 0·14 broad.

*Habitat.*—Fossil in Barbados.

3. *Sethoconus pileus*, n. sp.

Cephalis subspherical, free, with distinct collar stricture, a conical oblique horn of the same length, and small, irregular, roundish pores. Thorax flatly conical, about half as long as broad, with straight outlines; its pores subregular, hexagonal, half as broad as the cephalis, with very thin bars.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·08 long, 0·16 broad.

*Habitat.*—Central Pacific, Stations 262 to 274, surface.

4. *Sethoconus ampliatus*, Haeckel.

*Cornutella ampliata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 5.
*Ceratocyrtis ampliata*, Bütschli, 1882, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 536.

Cephalis, hemispherical, thorny, with a conical horn of twice the length; it is separated from the thorax by a complete internal collar septum, but without external collar stricture. Thorax flatly conical, about half as long as broad, with straight outlines; its pores subregular, hexagonal, about as large as the cephalis, with thin bars.

*Dimensions.*—Cephalis 0·015 long, 0·03 broad; thorax 0·08 long, 0·18 broad.

*Habitat.*—Fossil in Barbados.

5. *Sethoconus mitra*, Haeckel.

*Cornutella mitra*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 8.
*Ceratocyrtis mitra*, Bütschli, 1882, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 536.

Cephalis ovate, with slight collar stricture (not distinct enough in Ehrenberg's figure), with few large pores, and a conical stout horn of the same length. Thorax campanulate, conical, twice as long as broad, with slightly convex outlines; its pores subregular, roundish, increasing in size towards the mouth, the largest as broad as the cephalis.

*Dimensions.*—Cephalis, 0·03 long, 0·02 broad; thorax 0·12 long, 0·07 broad.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms; fossil in Barbados.

6. *Sethoconus rayianus*, n. sp. (Pl. 58, fig. 6)

*Conarachnium rayianum*, Haeckel, 1881, Prodromus, p. 430.

Cephalis ovate, with obliterated collar stricture (but distinct internal septum), with small, irregular pores, and two to four divergent horns, which are longer than the cephalis, and two or three of which are forked. Thorax tent-shaped, conical, two-thirds as long as broad, with slightly

concave outlines, and subregular, hexagonal pores, gradually increasing towards the mouth, the largest half as broad as the cephalis. This elegant species is dedicated to Dr. Ray, the discoverer of many rare Radiolarians in the Challenger collection.

*Dimensions.*—Cephalis 0·03 long, 0·02 broad; thorax 0·08 long, 0·12 broad.

*Habitat.*—Central Pacific, Stations 266 to 272, surface.

### 7. *Sethoconus cervus*, Haeckel.

? *Eucyrtidium cervus*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. ix. fig. 21.

*Conarachnium cervus*, Haeckel, 1881, Prodromus, p. 430.

Cephalis subspherical, with slight collar stricture, small circular pores, and two to four divergent horns, one or two of which are forked. Thorax wide, conical, about as long as broad, with straight outlines and irregular, polygonal pores, gradually increasing towards the mouth; the largest as broad as the cephalis.

*Dimensions.*—Cephalis 0·015 long, 0·02 broad; thorax 0·08 long, 0·08 broad.

*Habitat.*—Indian Ocean; Maldive Islands, surface (Haeckel); Zanzibar, depth 2200 fathoms (Pullen).

### 8. *Sethoconus lophophæna*, n. sp.

*Conarachnium lophophæna*, Haeckel, 1881, Prodromus, p. 430.

Cephalis subspherical, with distinct collar stricture, small circular pores, and numerous (twelve to sixteen) radial, bristle-shaped horns of different lengths. Thorax wide, conical, somewhat longer than broad, with slightly convex outlines, and subregular, hexagonal pores, increasing gradually in size towards the mouth; the largest twice as broad as the cephalis.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·2 long, 0·16 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

### 9. *Sethoconus larvatus*, Haeckel.

*Lophophæna larvata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 10.

*Dictyocephalus larvatus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 535.

Cephalis subspherical, large, with sharp collar stricture, and numerous (five to ten or more) radial, conical (partly forked) horns of different lengths. Thorax wide, conical, somewhat broader than long, with straight outlines. Pores of both joints very irregular, roundish, of very different sizes and form.

*Dimensions.*—Cephalis 0·04 long, 0·05 broad; thorax 0·1 long, 0·12 broad.

*Habitat.*—Fossil in Barbados.

10. *Sethoconus nassa*, Haeckel.

*Eucyrtidium nassa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. ix. fig. 9.

Cephalis slenderly ovate, with sharp collar stricture, few scattered pores, and a very stout, pyramidal horn of the same length, which is surrounded at the base by three short, divergent, ascending spines (perhaps the remnants of the three cortinar rods of *Eucecryphalus*, &c.?). Thorax slender, conical, with straight outlines, and small, dense, regular, circular pores of equal size.

*Dimensions.*—Cephalis 0·04 long, 0·02 broad; thorax 0·12 long, 0·08 broad.

*Habitat.*—Fossil in Barbados.

11. *Sethoconus tabulatus*, Haeckel.

*Cycladophora tabulata*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 289, Taf. iv. fig. 18.

Cephalis subspherical, with slight collar stricture, and numerous small, irregular pores, without horn, or with a small conical horn. Thorax slenderly conical, with straight outlines, and large, regular, hexagonal pores. Mouth truncate. (In the specimen I examined the thorax was longer and more conically dilated; the cephalis had a distinct small horn.)

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—North Atlantic, Antilles, depth 1600 fathoms (Ehrenberg); Station 347, depth 2250 fathoms.

Subgenus 2. *Cornutellium* (vel *Cerataracknium*), Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Cephalis very small, rudimentary, hyaline, without distinct collar septum, and without pores (or with scarce, rudimentary pores). Thorax smooth.

12. *Sethoconus hexagonalis*, Haeckel.

*Cornutella trochus*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. ix. fig. 14.

Cephalis very small, subspherical, hyaline, without pores, with a rudimentary horn of half the length. Thorax slenderly conical, or bottle-shaped, twice to three times as long as broad; in the lower half nearly cylindrical, with very thin, thread-like bars, and regular, hexagonal pores, increasing in size towards the mouth.

*Dimensions.*—Cephalis 0·005 diameter, thorax 0·12 long, 0·05 broad.

*Habitat.*—Indian Ocean, Zanzibar, depth 2200 fathoms (Pullen).

13. *Sethoconus verrucosus*, Haeckel.

*Cornutella verrucosa*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. ix. fig. 16.

Cephalis very small, subspherical, hyaline, without pores, with a rudimentary horn of half the

length. Thorax slenderly conical, or bottle-shaped, with little convex outlines; three to four times as long as broad, papillate, with regular, circular pores, which are included by rhombic frames, and increase in size towards the mouth.

*Dimensions.*—Cephalis 0·004 diameter, thorax 0·12 long, 0·035 broad.

*Habitat.*—Indian Ocean (Zanzibar), depth 2200 fathoms (Pullen).

### 14. *Sethoconus orthoceras*, n. sp. (Pl. 54, fig. 11).

*Cornutella orthoceras*, Haeckel, 1879, Atlas, *loc. cit.*

Cephalis very small, conical, hyaline, without pores, with a double internal stricture, and a very short, rudimentary horn. Thorax slenderly conical, with undulate outlines, three to four times as long as broad, with subregular, roundish pores, gradually increasing in size towards the mouth.

*Dimensions.*—Cephalis 0·02 long, 0·01 broad; thorax 0·16 long, 0·04 to 0·08 broad.

*Habitat.*—South Atlantic, Station 325, surface.

### 15. *Sethoconus profundus*, Haeckel.

*Cornutella profunda*, Ehrenberg, 1854, Mikrogeol., Taf. xxxv. B, Nr. B. iv. fig. 21.
*Cornutella profunda*, Bailey, 1856, Amer. Jour., vol. xxii. pl. i. fig. 23.
*Cornutella profunda*, Haeckel, 1862, Monogr. d. Radiol., p. 284.

Cephalis very small, spherical, hyaline, without pores and internal stricture, with a very short, rudimentary horn. Thorax slenderly conical, with straight outlines, three to four times as long as broad, with subregular, circular pores, gradually increasing in size towards the mouth.

*Dimensions.*—Cephalis 0·004 to 0·008 diameter, thorax 0·08 to 0·12 long, 0·03 to 0·04 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific; at various depths.

### 16. *Sethoconus trichostylus*, Haeckel.

*Cornutella trichostyla*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. vi. fig. 2.

Cephalis very small, conical, hyaline, without pores, with a very long, bristle-shaped, spirally twisted horn, longer than the whole shell. Thorax slenderly conical, with straight outlines, and very small, regular, circular pores of nearly equal size, which are separated by broader bars and spirally ascending oblique crests (according to the figure).

*Dimensions.*—Cephalis 0·004 long, 0·002 broad; thorax 0·06 long, 0·04 broad.

*Habitat.*—North Pacific (California), depth 2600 fathoms.

### 17. *Sethoconus longisetus*, Haeckel.

*Cornutella longiseta*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. ix. fig. 15.

Cephalis very small, spherical, hyaline, without pores, with a very long, bristle-shaped horn,

nearly as long as the shell. Thorax slenderly conical, rough, with straight outlines, and irregular, roundish pores, gradually increasing in size towards the mouth.

*Dimensions.*—Cephalis 0·01 diameter, thorax 0·09 long, 0·03 broad.

*Habitat.*—Indian Ocean (Zanzibar), depth 2200 fathoms (Pullen).

18. *Sethoconus gracilis*, Haeckel.

*Eucyrtidium gracile*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 15.

Cephalis small, subspherical, with few scarce pores, and a stout, pyramidal horn, of the same length. Thorax slenderly conical, three to four times as long as broad, with straight outlines, and very small and numerous circular pores of equal size.

*Dimensions.*—Cephalis 0·015 diameter, thorax 0·12 long, 0·04 broad.

*Habitat.*—Fossil in Barbados.

19. *Sethoconus bimarginatus*, n. sp. (Pl. 54, fig. 12).

*Cornutella bimarginata*, Haeckel, 1879, Atlas, *loc. cit.*

Cephalis very small, subspherical, hyaline, without pores, with a rudimentary, conical horn of the same length. Thorax slenderly conical, three times as long as broad, with undulated, little convex outlines, and irregular, roundish, double-contoured pores, arranged in nine longitudinal series, markedly increasing in size towards the mouth.

*Dimensions.*—Cephalis 0·01 diameter, thorax 0·16 long, 0·05 broad.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

20. *Sethoconus clathratus*, Haeckel.

*Cornutella clathrata*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 39*a*, *b*, *c*.

Cephalis very small, subspherical, hyaline, without pores, with a rudimentary horn of half the length. Thorax slenderly conical, three to four times as long as broad, smooth, with curved axis and small, regular, circular pores, nearly equal in size. This common species differs from all others of the genus by the curvation of the axis of the shell, which is more or less crescentic, or curved like a cowherd's horn; it may, therefore, represent a peculiar genus, *Sethodrepanum*.

*Dimensions.*—Cephalis 0·003 to 0·006 diameter, thorax 0·08 to 0·16 long, 0·03 to 0·05 broad.

*Habitat.*—Cosmopolitan; Atlantic, Pacific, many stations; fossil in Barbados and Sicily.

## Subgenus 3. *Phlebarachnium*, Haeckel (et *Cladarachnium*, Haeckel), 1881, Prodromus, p. 430.

*Definition.*—Cephalis small, with very small pores, and internal collar septum. Thorax spiny or thorny.

21. *Sethoconus facetus*, n. sp. (Pl. 55, fig. 1).

*Phlebarachnium facetum*, Haeckel, 1881, Prodromus, p. 430.

Cephalis small, hemispherical, with distinct collar septum, the same network as the thorax, and numerous bristle-shaped horns of the same length. Thorax wide, conical, about as long as broad, with slightly convex outlines; its network extremely delicate, with very small and numerous, regular, hexagonal pores, disposed in numerous divergent, longitudinal series, which are convoluted somewhat spirally around the shell axis. Surface covered with thin, scattered, bristle-shaped spines, about as long as the cephalis.

*Dimensions.*—Cephalis 0·02 diameter, thorax 0·2 long, 0·22 broad.

*Habitat.*—Central Pacific, Stations 271 to 274, surface.

22. *Sethoconus anthocyrtis*, n. sp. (Pl. 62, fig. 21).

*Anthocyrtis sethoconus*, Haeckel, 1879, Atlas, *loc. cit.*

Cephalis small, subspherical, with very small pores and numerous radial, bristle-shaped spines of the same length. Thorax wide, conical, about as long as broad, with parabolic outlines, its network very delicate, with subregular, hexagonal meshes. Surface with scarce, bristle-shaped spines (not represented in the figure). Mouth with a corona of numerous small, vertical spines.

*Dimensions.*—Cephalis 0·025 diameter, thorax 0·26 long, 0·24 broad.

*Habitat.*—North Pacific, Station 248, surface.

23. *Sethoconus virgultus*, n. sp.

*Cladarachnium virgultum*, Haeckel, 1881, Prodromus, p. 430.

Cephalis and thorax nearly of the same form and stricture as in *Sethoconus facetus*, but larger and wider, with the same delicate, hexagonal network (Pl. 55, fig. 1); it differs from the latter by the wider, more convex and campanulate form, but mainly by the armature of the surface, which is densely covered with thin, arborescent, bristle-shaped spines, irregularly branched, and four to eight times as large as the cephalis.

*Dimensions.*—Cephalis 0·02 diameter, thorax 0·32 long, 0·4 broad.

*Habitat.*—South Pacific, Station 288, surface.

24. *Sethoconus setosus*, n. sp.

*Phlebarachnium setosum*, Haeckel, 1881, Prodromus, p. 430.

Cephalis small, subspherical, with distinct collar septum, and the same network as the thorax, with numerous bristle-shaped horns of the same length. Thorax slenderly conical, twice as long as broad, with irregular, polygonal pores of little different sizes, and very thin bars. Surface covered with perpendicular, simple, bristle-shaped spines, about as long as the cephalis.

*Dimensions.*—Cephalis 0·02 diameter, thorax 0·12 long, 0·22 broad.

*Habitat.*—Central Pacific, Stations 266 to 272, surface.

25. *Sethoconus venosus*, n. sp. (Pl. 55, fig. 2).

*Phlebarachnium venosum*, Haeckel, 1881, Prodromus, p. 430, et Atlas, *loc. cit.*

Cephalis subspherical, with a stout prismatic horn twice the length, bearing three denticulate edges. The uppermost part of the thorax is supported by three diverging, radial beams arising from the deep collar stricture. Thorax wide, conical, nearly twice as long as broad, with slightly convex, thorny outlines; its delicate network is composed of very irregular, polygonal meshes of different sizes, separated by stronger bars, and of numerous very small polygonal pores separated by very thin bars inside the former. The central capsule of the figured specimen exhibited in the upper third of the thorax four large club-shaped lobes, which arose from a very small sphere enclosed in the cephalis and containing the nucleus.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·4 long, 0·3 broad.

*Habitat.*—Central Pacific, Station 271, surface.

Genus 573. *Periarachnium*,[1] Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Sethocorida (vel Dicyrtida eradiata aperta) with conical or campanulate, gradually dilated thorax, and widely open mouth. Primary lattice-shell enveloped by an external arachnoidal mantle. Cephalis with one or more horns.

The genus *Periarachnium* has been derived from those forms of the preceding *Sethoconus*, in which the conical thorax is covered with simple spines (*Phlebarachnium*) or branched spines (*Cladarachnium*). By communication of the branches of these spines a second outer shell is formed, which, like an arachnoidal mantle, envelops the inner primary shell.

1. *Periarachnium periplectum*, n. sp. (Pl. 55, fig. 11).

Cephalis hemispherical, separated from the thorax by a sharp collar stricture, from which arise three internal, diverging beams supporting its upper third. Thorax campanulate, conical, about as long as broad, with slightly convex outlines. The delicate lattice-work of the entire shell is double; the inner composed of subregular, hexagonal meshes; the outer of larger, irregular, polygonal meshes. The bars of the inner are much thicker than the thin threads of the outer. Both shells are connected by numerous bristle-shaped beams. The central capsule of the figured specimen exhibited in the upper part of the thorax three club-shaped lobes, which arose from a sphere enclosed in the cephalis and containing the nucleus.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·15 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 271, surface.

[1] *Periarachnium*=Shell enveloped by cobweb; περί, ἀράχνιον.

Genus 574. *Sethocephalus*,[1] Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Sethocorida (vel Dicyrtida eradiata aperta) with discoidal, flatly expanded thorax. Cephalis large, without horn.

The genus *Sethocephalus* (formerly proposed under the name *Platycryphalus*) contains some few and rare Sethocorida, distinguished by the very large cephalis, the collar opening of which is wide open, not closed by cortinar beams, and surrounded by a very flat, nearly discoidal thorax, like the brim of a hat. It is possible that this peculiar genus has been derived from a Tricyrtid (*Theocalyptra?*) by loss of the original cephalis, and that the apparent large cephalis is the original thorax.

1. *Sethocephalus eucecryphalus*, n. sp. (Pl. 56, fig. 13).

Cephalis very large, campanulate-conical, with irregular, polygonal pores and thin bars. Thorax short, scarcely broader than the cephalis, beyond the sharp collar stricture expanded like the brim of a hat, with few rows of irregular, polygonal pores. (In the specimen figured the thorax was only half as broad as in another specimen found afterwards.)

*Dimensions.*—Cephalis 0·12 long, 0·09 broad; thorax 0·02 long, 0·12 broad.

*Habitat.*—South Pacific, Station 285, surface.

2. *Sethocephalus platycryphalus*, n. sp.

*Platycryphalus sethodiscus*, Haeckel, 1881, Prodromus, p. 430.

Cephalis large, hemispherical, with irregular square pores and thin bars. Thorax flatly conical, three to four times as broad as the cephalis, beyond the collar stricture expanded nearly discoidally, with a delicate network of small, subregular, hexagonal pores. (Similar in general form to *Sethophormis aurelia*, Pl. 55, fig. 3, but without any trace of collar beams or radial ribs.)

*Dimensions.*—Cephalis 0·04 long, 0·08 broad; thorax 0·04 long, 0·3 broad.

*Habitat.*—South Pacific, Station 289, surface.

Genus 575. *Sethocyrtis*,[2] n. gen.

*Definition.*—Sethocorida (vel Dicyrtida eradiata aperta) with ovate or subcylindrical thorax, the mouth of which is constricted, simple, without prominent hyaline peristome. Cephalis with an apical horn.

[1] *Sethocephalus*=Sieve-head; σήθω, κεφαλή.

[2] *Sethocyrtis*=Sieve-basket; σήθω, κυρτίς.

The genus *Sethocyrtis* and the three following nearly allied genera differ from the three preceding genera of Sethocorida in the form of the thorax, which is not gradually dilated, conical, but cylindrical or ovate, with more or less constricted mouth. *Sethocyrtis* may be derived from *Anthocyrtis* by loss of the terminal feet. Its mouth is quite simple, without tubular or annular peristome.

1. *Sethocyrtis oxycephalis*, n. sp. (Pl. 62, fig. 9).

Shell rough, subconical, with slight collar stricture. Length of the two joints = 4 : 9, breadth = 3 : 8. Cephalis ovate, with a pyramidal horn of half the length. Thorax campanulate, with regular, circular pores, twice as broad as those of the cephalis. Mouth constricted, scarcely half as broad as the thorax.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 3000 fathoms.

2. *Sethocyrtis cancrina*, Haeckel.

*Eucyrtidium cancrinum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 4.

Shell smooth, bottle-shaped, with obliterated collar stricture. Length of the two joints = 4 : 9, breadth = 2 : 7. Cephalis subcylindrical, with a stout conical horn of the same length, and sometimes a smaller accessory horn at its base. Thorax ovate, truncate, with regular, circular, quincuncial pores, twice as broad as those of the cephalis. Mouth little constricted, flat, nearly as broad as the thorax.

*Dimensions.*—Cephalis 0·04 long, 0·02 broad; thorax 0·09 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

3. *Sethocyrtis diomedis*, n. sp.

Shell thorny, pear-shaped, with slight collar stricture. Length of the two joints = 3 : 16, breadth = 4 : 20. Cephalis hemispherical, with a conical horn of twice the length. Thorax inflate, ovate, truncate at both poles, with regular, circular pores, twice as broad as those of the thorax. Mouth constricted, flat, half as broad as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·12 to 0·16 long, 0·16 to 0·2 broad.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms; also fossil in Barbados.

4. *Sethocyrtis menelai*, n. sp.

Shell spiny, pear-shaped, with sharp collar stricture. Length of the two joints = 3 : 15, breadth = 4 : 18. Cephalis subspherical, with a large, cylindro-conical horn, about as long as the whole shell.

Thorax inflate, subspherical, truncate, with large, irregular, roundish pores, four to six times as large as those of the cephalis. Mouth constricted, flat, one-third as broad as the thorax.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·15 long, 0·18 broad.

*Habitat.*—Fossil in Barbados.

### 5. *Sethocyrtis subacuta*, Haeckel.

*Eucyrtidium subacutum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 18.

Shell smooth, pear-shaped, with sharp collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 3. Cephalis subspherical, with small, irregular pores and a rudimentary horn of half the length. Thorax ovate, with large, subregular, hexagonal pores and thin bars between them. Mouth constricted, flat, half as broad as the thorax, without prominent peristome.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—Philippine Sea, depth 3300 fathoms (Ehrenberg).

### 6. *Sethocyrtis pleuracantha*, Haeckel.

*Eucyrtidium pleuracanthum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 21.

Shell smooth, bottle-shaped, with distinct collar stricture. Length of the two joints = 2 : 4 breadth = 1 : 3. Cephalis slenderly ovate, with an excentric pyramidal horn of the same length. Thorax inflate, ovate, with irregular, roundish pores and thin bars between them. Mouth constricted, flat, half as broad as the thorax, without prominent peristome.

*Dimensions.*—Cephalis 0·04 long, 0·02 broad; thorax 0·08 long, 0·06 broad.

*Habitat.*—Tropical Pacific, Stations 200, 225, 266, 274, &c., at various depths.

### 7. *Sethocyrtis agamemnonis*, n. sp. (Pl. 62, figs. 11, *a*, *b*).

Shell pear-shaped, rough, with sharp collar stricture. Length of the two joints = 2 : 10, breadth = 3 : 8. Cephalis subspherical, with very small pores and a small, pyramidal horn of half the length. Thorax inflate, ovate; in the uppermost part (beyond the collar stricture) with a ring of six to nine very large roundish pores, which are twice to four times as broad as the other irregular, roundish pores. (The shell is seen in fig. 11 from the apical pole, in fig. 11*a* with the cephalis, in fig. 11*b* without it, exhibiting the four central collar pores of the cortinar septum.) Mouth truncate, without prominent peristome.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·1 long, 0·08 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

8. *Sethocyrtis cassis*, Haeckel.

*Cornutella cassis*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 38.
*Cyrtocalpis cassis*, Haeckel, 1862, Monogr. d. Radiol., p. 287.

Shell pear-shaped, smooth, with obliterated collar stricture. Length of the two joints = 4 : 13, breadth = 3 : 12. Cephalis ovate, with a conical horn of half the length. Thorax inflate, ovate, with subregular, circular, quincuncial pores, twice to three times as broad as the bars. Mouth constricted, truncate, two-thirds as broad as the thorax, without prominent peristome.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·13 long, 0·12 broad.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Caltanisetta).

Genus 576. *Sethocorys*,[1] Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Sethocorida (vel Dicyrtida eradiata aperta) with ovate or subcylindrical thorax, the mouth of which is constricted and prolonged into a ring-like peristome. Cephalis with an apical horn.

The genus *Sethocorys* differs from the preceding *Sethocyrtis*, its ancestral form, in the form of the constricted mouth, which is prolonged into a prominent, hyaline, tubular, or annular peristome.

1. *Sethocorys achillis*, n. sp. (Pl. 62, fig. 8).

Shell rough, pear-shaped, with distinct collar stricture. Length of the two joints = 4 : 8, breadth = 3 : 8. Cephalis ovate, with a stout pyramidal horn of half the length. Thorax nearly spherical, with regular, circular, quincuncial pores of the same breadth as the cephalic pores. Mouth constricted, half as broad as the thorax, with a broad, smooth, striated peristome.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·08 long, 0·08 broad.

*Habitat.*—Cosmopolitan; Mediterranean (Corfu), Atlantic, Indian, Pacific; many stations, at various depths.

2. *Sethocorys patrocli*, n. sp.

Shell thorny, pear-shaped, with slight collar stricture. Length of the two joints = 4 : 12, breadth = 3 : 10. Cephalis ovate, with a pyramidal horn of twice the length. Thorax ovate, truncate at both poles, with regular, circular pores, twice as broad as the cephalic pores. Mouth constricted, half as broad as the thorax, with a broad, smooth, prominent peristome.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·12 long, 0·1 broad.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 3000 fathoms.

[1] *Sethocorys* = Sieve-helmet; σήθω, κόρυς.

3. *Sethocorys armadillo*, Haeckel.

*Eucyrtidium armadillo*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. ix. fig. 10.

Shell slenderly ovate, smooth, with deep collar stricture. Length of the two joints = 3 : 10, breadth = 4 : 6. Cephalis ovate, at the apex thorny, with a conical horn of the same length. Thorax smooth, ovate, truncate, with small, regular, circular pores, disposed in from twelve to fifteen transverse rows of the same breadth as the cephalic pores. Mouth constricted, half as broad as the thorax, with a broad, hyaline, prominent peristome.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·1 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

4. *Sethocorys odysseus*, n. sp. (Pl. 62, fig. 10).

Shell ovate, smooth, with obliterated collar stricture. Length of the two joints = 2 : 9, breadth = 4 : 8. Cephalis hemispherical, with a slender, conical horn of the same length. Thorax nearly spherical, with regular, circular pores, of the same breadth as the cephalic pores, quincuncially disposed. Mouth constricted, only one-third as broad as the thorax, with a broad, hyaline, prominent peristome.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

5. *Sethocorys amphora*, Haeckel.

*Lophophæna amphora*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 99, Taf. iii. fig. 11.

Shell ovate, mouth with distinct collar stricture. Length of the two joints = 1 : 5, breadth = 2 : 4. Cephalis hemispherical, with a short conical horn of half the length. Thorax ovate, truncate, with small, regular, circular, quincuncial pores. Mouth constricted, half as broad as the thorax, with a narrow, prominent, hyaline peristome.

*Dimensions.*—Cephalis 0·015 long, 0·03 broad; thorax 0·07 long, 0·06 broad.

*Habitat.*—Fossil in Tertiary rocks of Sicily; Grotte (Stöhr).

6. *Sethocorys ájacis*, n. sp.

Shell slenderly ovate, smooth, without external collar stricture, but with an internal septum. Length of the two joints = 1 : 3, breadth = 1 : 2. Cephalis conical, with a large pyramidal horn of twice the length, and sometimes with a smaller accessory horn at its base; its pores scarce, irregular. Thorax ovate, truncate, hyaline, in the greater part without pores, in the smaller part

with from two to four transverse rows of small, circular pores only. Mouth constricted, with a large cylindrical, tubular, hyaline peristome, half as long as the shell.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·09 long, 0·07 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Genus 577. *Lophophæna*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Sethocorida (vel Dicyrtida eradiata aperta) with ovate or subcylindrical thorax, the mouth of which is either truncate or constricted. Cephalis armed with several large horns.

The genus *Lophophæna* differs from the nearly allied *Sethocorys* and *Dictyocephalus* only in the armature of the large cephalis, which bears a group of large horns, often arranged in a corona of radial spines. Sometimes these spines are connected by anastomosing branches (like *Arachnocorys*).

### Subgenus 1. *Lophophænula*, Haeckel.

*Definition.*—Horns of the cephalis simple, free, radial spines, neither branched nor connected.

#### 1. *Lophophæna galea*, Ehrenberg.

*Lophophæna galea orci*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 245.
*Lophophæna apiculata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 11.
? *Cornutella spiniceps*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. ii. fig. 6.

Shell with slight collar stricture. Length of the two joints = 5 : 4, breadth = 5 : 6. Cephalis subglobular, with numerous bristle-shaped, radial spines, about as long as its radius. Thorax about the same size, truncate, conical, smooth, with wide open mouth. Pores in both joints of equal size, small, regular, circular.

*Dimensions.*—Cephalis 0·05 long, 0·05 broad; thorax 0·04 long, 0·06 broad.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms; also fossil in Barbados.

#### 2. *Lophophæna radians*, Ehrenberg.

*Lophophæna radians*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 9.
? *Lophophæna lynx*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. fig. 13.

Shell with slight collar stricture. Length of the two joints = 4 : 6, breadth = 4 : 5. Cephalis subglobular, with numerous, stout, conical, radial spines, about as long as its diameter. Thorax

[1] *Lophophæna* = Shell with a top-knot; λόφος, φαίνω.

of about the same size, subcylindrical, smooth, truncate, with wide open mouth. Pores in both joints of equal size, small, regular, circular.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·06 long, 0·05 broad.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific; also fossil in Barbados.

### 3. *Lophophæna liothorax*, n. sp.

Shell with distinct collar stricture. Length of the two joints = 4 : 10, breadth = 4 : 8. Cephalis subglobular, with large, circular, hexagonally-framed pores, and with numerous stout, conical, radial spines, about as long as its diameter. Thorax twice as long, ovate, smooth, truncate, with little constricted mouth, and with irregular, roundish pores, of very different sizes.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·1 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

### 4. *Lophophæna echinocephala*, n. sp.

Shell with deep collar stricture. Length of the two joints = 4 : 8, breadth = 4 : 9. Cephalis subglobular, of the same shape as in the preceding species. Thorax thorny, inflate, nearly spherical, with a constricted mouth of half the breadth, and with irregular, roundish, double-contoured pores.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·08 long, 0·09 broad.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

## Subgenus 2. *Lophophænoma*, Haeckel.

*Definition.*—Horns of the cephalis connected by anastomosing branches.

### 5. *Lophophæna circumtexta*, Haeckel.

*Lophophæna radians*, var., Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. viii. figs. 7, 8.

Shell with slight collar stricture. Length of the two joints = 4 : 5, breadth = 4 : 5. Cephalis subglobular, with numerous conical, radial spines, about as long as its diameter, and at equal distances from the surface, connected by anastomosing branches. Thorax nearly cylindrical, smooth, little dilated towards the truncate, wide open mouth. Pores subregular, circular.

*Dimensions.*—Cephalis 0·04 long, 0·04 broad; thorax 0·05 long, 0·05 broad.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms; also fossil in Barbados.

Genus 578. *Dictyocephalus*,[1] Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 830.

*Definition.*—Sethocorida (vel Dicyrtida eradiata aperta) with ovate or subcylindrical thorax, the mouth of which is more or less constricted, either truncate or with a ring-like peristome. Cephalis rounded, without horn.

The genus *Dictyocephalus* has originated probably from *Sethocorys* by reduction and loss of the apical horn. The mouth is more or less constricted, either simple, truncate (*Dictyocryphalus*), or provided with a prominent, broad, hyaline, annular peristome (*Dictyoprora*).

Subgenus 1. *Dictyoprora*, Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Mouth of the thorax constricted, with a prominent, ring-like or tubular, hyaline peristome.

1. *Dictyocephalus amphora*, n. sp. (Pl. 62, fig. 4).

Shell smooth, thick-walled, subovate, with slight collar stricture. Length of the two joints = 5 : 9, breadth = 6 : 8. Cephalis large, obtusely conical, with numerous oblique pore-canals. Thorax inflate, with six to eight transverse rows of roundish pores, increasing in size towards the base. Mouth constricted, one-third as broad as the thorax, with an internal diaphragm and a narrow hyaline peristome.

*Dimensions.*—Cephalis 0·05 long, 0·06 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 265 to 272, depth 2425 to 2925 fathoms.

2. *Dictyocephalus urceolus*, n. sp.

? *Eucyrtidium Mongolfieri*, Bury, 1862, Polycystins of Barbados, pl. v. fig. 2.

Shell smooth, thick-walled, urceolate, with obliterated collar stricture. Length of the two joints = 5 : 12, breadth = 4 : 10. Cephalis campanulate, with numerous oblique pore-canals. Thorax inflate, with five or six transverse rows of roundish pores of equal size. Mouth constricted, nearly half as broad as the thorax, with a broad hyaline peristome.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·12 long, 0·1 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

[1] *Dictyocephalus* = Latticed head; δίκτυον, κεφαλή.

3. *Dictyocephalus excellens*, Haeckel.

*Eucyrtidium excellens*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 2.

Shell annulate, thick-walled, urceolate, with slight collar stricture. Length of the two joints = 5 : 10, breadth = 4 : 7. Cephalis large, ovate-conical, with numerous oblique pore-canals. Thorax ovate, with ten to twelve transverse rows of regular, roundish pores, which are separated by prominent annular ribs. Mouth constricted, about half as broad as the thorax, with a broad hyaline peristome.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·1 long, 0·07 broad.

*Habitat.*—Fossil in Barbados.

4. *Dictyocephalus ocellatus*, Haeckel.

*Dictyocephalus ocellatus*, Haeckel, 1862, Monogr. d. Radiol., p. 297.

? *Eucyrtidium ocellatum*, Ehrenberg, 1861, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 299.

Shell smooth, thick-walled, with deep collar stricture. Length of the two joints = 3 : 9, breadth = 4 : 7. Cephalis subspherical, with numerous oblique pore-canals. Thorax inflate, campanulate, hyaline, only with three or four remote transverse rows of circular, double-contoured pores of equal size. Mouth constricted, one-third as broad as the thorax, with a narrow hyaline annular peristome.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·09 long, 0·07 broad.

*Habitat.*—North Atlantic, Greenland; Færöe Channel (Gulf Stream), John Murray.

5. *Dictyocephalus crassiceps*, Haeckel.

*Eucyrtidium crassiceps*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 4.

Shell smooth, thick-walled, with sharp collar stricture. Length of the two joints = 4 : 6, breadth = 3 : 4. Cephalis ovate, in the upper part with scattered pores, in the lower part with one transverse row of pores. Thorax hyaline, subcylindrical, only with four or five remote transverse rows of small, circular pores. Mouth constricted, half as broad as the thorax, with a short hyaline peristome.

*Dimensions.*—Cephalis 0·04 long, 0·03 broad; thorax 0·06 long, 0·04 broad.

*Habitat.*—Fossil in Barbados.

6. *Dictyocephalus australis*, n. sp. (Pl. 62, fig. 1).

Shell smooth, thick-walled, with slight collar stricture. Length of the two joints = 2 : 9, breadth = 3 : 6. Cephalis hemispherical, with few small pores. Thorax subcylindrical, with large,

roundish, double-contoured pores, irregularly disposed. Mouth constricted, two-thirds as broad as the thorax, with a broad, hyaline peristome.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·09 long, 0·06 broad.

*Habitat.*—East coast of Australia, Station 164, surface.

7. *Dictyocephalus mediterraneus*, n. sp. (Pl. 62, fig. 2).

Shell rough, thin-walled, with slight collar stricture. Length of the two joints = 3 : 10, breadth = 4 : 8. Cephalis hemispherical, with small, circular pores. Thorax ovate, truncate, with much larger circular pores of different sizes and thin bars between them. Mouth little constricted, two-thirds as broad as the thorax, with a narrow, hyaline peristome.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·1 long, 0·08 broad.

*Habitat.*—Mediterranean, Smyrna (Haeckel), surface.

8. *Dictyocephalus papillosus*, Haeckel.

*Eucyrtidium papillosum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 10.

Shell thin-walled, papillate, with obliterated collar stricture. Length of the two joints = 2 : 7, breadth = 3 : 5. Cephalis hemispherical, with small, circular pores. Thorax slenderly ovate, with larger, subregular, circular pores, separated by oblique series of conical papillæ. Mouth with a broad, hyaline peristome (the "third articulus" of Ehrenberg), separated by a stricture from the little broader thorax.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·07 long, 0·05 broad.

*Habitat.*—Western Tropical Pacific (Philippine Sea), depth 3300 fathoms.

9. *Dictyocephalus tabulatus*, n. sp.

Shell thin-walled, papillate, with obliterated collar stricture. Length of the two joints = 2 : 10, breadth = 3 : 7. Cephalis hemispherical, with small, circular pores. Thorax slenderly ovate, truncate, with large, subregular, circular, hexagonally-framed pores. Mouth little constricted nearly as broad as the thorax, with a broad, hyaline peristome.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·1 long, 0·07 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

10. *Dictyocephalus reticulum*, Haeckel.

*Dictyocephalus reticulum*, Haeckel, 1862, Monogr. d. Radiol., p. 297.

*Eucyrtidium reticulum*, Ehrenberg, 1861, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 300.

Shell thin-walled, smooth, with deep collar stricture. Length of the two joints = 2 : 8, breadth = 3 : 5. Cephalis subspherical, with small, circular pores. Thorax campanulate, with

transverse rows of alternating square pores. Mouth little constricted, nearly as long as the thorax, with a narrow, prominent peristome.

*Dimensions.*—Cephalis 0·02 long, 0·03 broad; thorax 0·08 long, 0·05 broad.

*Habitat.*—Arctic Ocean, Greenland (Schaffner); Iceland (Krabbe).

### 11. *Dictyocephalus ampulla*, n. sp.

Shell thin-walled, smooth, with slight collar stricture. Length of the two joints = 1 : 4, breadth = 1 : 3. Cephalis subspherical, without pores, hyaline. Thorax inflate, subspherical, with scarce and small, widely-scattered, circular pores. Mouth constricted, only one-third as broad as the thorax, with a narrow, prominent peristome.

*Dimensions.*—Cephalis 0·02 long, 0·02 broad; thorax 0·08 long, 0·07 broad.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Subgenus 2. *Dictyocryphalus*, Haeckel, 1881, Prodromus, p. 430.

*Definition.*—Mouth of the thorax flat or truncate, without prominent ring-like peristome.

### 12. *Dictyocephalus obtusus*, Ehrenberg.

*Dictyocephalus obtusus*, Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 830.
*Lophophæna obtusa*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 40.
*Cornutella obtusa*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 877.
*Dictyocephalus obtusus*, Haeckel, 1862, Monogr. d. Radiol., p. 296.

Shell smooth, thick-walled, with distinct collar stricture. Length of the two joints = 5 : 6 breadth = 4 : 5. Cephalis ovate, little smaller than the subcylindrical thorax. Pores subregular, circular, of little different sizes. Mouth truncate, without ring-like peristome.

*Dimensions.*—Cephalis 0·05 long, 0·04 broad; thorax 0·06 long, 0·05 broad.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Caltanisetta), Grotte, &c.

### 13. *Dictyocephalus globiceps*, n. sp. (Pl. 62, fig. 7).

Shell rough, thin-walled, with distinct collar stricture. Length of the two joints = 6 : 8, breadth = 6 : 7. Cephalis subspherical, large, with circular, double-contoured pores. Thorax cylindrical, with irregular, roundish pores, the size of which, like the thickness of the wall, decreases gradually towards the truncate mouth, which has no ring-like peristome.

*Dimensions.*—Cephalis 0·06 long, 0·06 broad; thorax, 0·08 long, 0·07 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

14. *Dictyocephalus cavea*, n. sp.

Shell rough, thin-walled, with slight collar stricture. Length of the two joints = 3 : 10 = breadth = 5 : 7. Cephalis hemispherical, thorny, with numerous regular, circular pores. Thorax subcylindrical, with very large, circular, hexagonally-framed pores (in nine longitudinal alternating rows), three to five times as broad as the cephalic pores. Mouth truncate, wide open, without ring-like peristome.

*Dimensions.*—Cephalis 0·06 long, 0·1 broad; thorax 0·2 long, 0·14 broad.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

15. *Dictyocephalus capito*, Ehrenberg.

*Dictyocephalus capito*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 289, Taf. vii. fig. 24.

Shell smooth, thin-walled, with sharp collar stricture. Length of the two joints = 7 : 9, breadth = 6 : 8. Cephalis ovate, with numerous irregular, roundish, densely-crowded pores. Thorax ovate, with very few widely-scattered, irregular, roundish pores (broken off in Ehrenberg's figure). Mouth truncate, little constricted, without ring-like peristome.

*Dimensions.*—Cephalis 0·07 long, 0·06 broad; thorax 0·09 long, 0·08 broad.

*Habitat.*—Western Tropical Pacific (Philippine Sea) Station 206, depth 2100 fathoms.

16. *Dictyocephalus hispidus*, Ehrenberg.

*Dictyocephalus hispidus*, Ehrenberg, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin; Abhandl. d. k. Akad. d. Wiss. Berlin, 1872, p. 289, Taf. v. fig. 18.

Shell rough, thin-walled, with deep collar stricture. Length of the two joints = 3 : 4, breadth = 3 : 5. Cephalis subspherical, spiny, with the same irregular, roundish pores as the funnel-shaped or nearly ovate thorax. Mouth truncate, little narrower than the thorax, without ring-like peristome.

*Dimensions.*—Cephalis 0·03 long, 0·03 broad; thorax 0·04 long, 0·05 broad.

*Habitat.*—Tropical Atlantic, Mexican Gulf (Ehrenberg); Station 338, depth 1990 fathoms.

Subfamily 2. SETHOCAPSIDA, Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethocyrtida with the basal mouth of the shell fenestrated (vel Dicyrtida eradiata clausa).

Genus 579. *Sethocapsa*,[1] Haeckel, 1881, Prodromus, p. 433 (sensu emendato).

*Definition.*—Sethocapsida (vel Dicyrtida eradiata clausa) with a free cephalis bearing an apical horn.

The genus *Sethocapsa* and the two following genera represent together the small subfamily of Sethocapsida, or those Dicyrtida in which the mouth of the thorax is closed, and no radial apophyses are present. *Sethocapsa* may be derived either from *Lithopera* by loss of the three radial rods, or from *Sethocyrtis* by closure of the mouth.

1. *Sethocapsa pyriformis*, n. sp. (Pl. 57, fig. 2).

Shell rough, pear-shaped, with slight collar stricture. Length of the two joints = 3 : 10, breadth = 3 : 8. Cephalis subspherical, with numerous small pores, and a short pyramidal or conical horn of half the length. Thorax ovate, with subregular, circular, quincuncial pores.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·1 long, 0·08 broad.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 3000 fathoms.

2. *Sethocapsa lagena*, Haeckel.

*Lithopera lagena*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 4.

Shell smooth, pear-shaped, with sharp collar stricture. Length of the two joints = 3 : 8, breadth = 3 : 6. Cephalis pear-shaped, with few scarce pores, and a small conical horn of half the length. Thorax pear-shaped, with irregular, roundish pores. This species differs from the similar *Lithopera lagena* almost only in the complete absence of the three internal radial collar beams inside the thorax, and may be derived from it by their retrograde metamorphosis.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·08 long, 0·06 broad.

*Habitat.*—Fossil in Barbados.

3. *Sethocapsa macroceros*, n. sp.

Shell smooth, pear-shaped, with slight collar stricture. Length of the two joints = 2 : 11, breadth = 2 : 9. Cephalis subspherical, with small circular pores, and a very large, straight, pyramidal horn, of about the same length as the shell. Thorax ovate, with large, irregular, roundish pores, which are surrounded by polygonal frames.

*Dimensions.*—Cephalis 0·02 diameter, thorax 0·11 long, 0·09 broad.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

[1] *Sethocapsa* = Sieve-capsule; σήθω, κάψα.

4. *Sethocapsa nidus*, Haeckel.

*Lithopera nidus pendulus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 7.

Shell smooth, pear-shaped, with distinct collar stricture. Length of the two joints = 3 : 6, breadth = 3 : 5. Cephalis subspherical, with a large, straight, pyramidal horn of twice the length, and scarce small pores. Thorax ovate, also with very small and scarce pores.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·06 long, 0·05 broad.

*Habitat.*—Fossil in Barbados.

5. *Sethocapsa bulla*, n. sp.

Shell spiny, with slight collar stricture. Length of the two joints = 3 : 12, breadth = 4 : 12. Cephalis hemispherical, with small, scarce pores, and a conical horn of the same length. Thorax nearly spherical, with large, subregular, circular, quincuncial pores, twice as broad as the bars.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·12 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; fossil in Barbados.

6. *Sethocapsa ampulla*, n. sp.

Shell papillate, with slight collar stricture. Length of the two joints = 1 : 5, breadth = 1 : 5. Cephalis hemispherical, hyaline, without pores, with a large pyramidal horn of twice the length. Thorax nearly spherical, with large, irregular, roundish, lobulated pores.

*Dimensions.*—Cephalis 0·03 long, 0·04 broad; thorax 0·15 long, 0·15 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

7. *Sethocapsa staurocephala*, Haeckel.

? *Lithopera oxystauros*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 6.

? *Lithopera amblystauros*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iii. fig. 5.

Shell smooth, with slight collar stricture. Length of the two joints = 3 : 4, breadth = 3 : 4. Cephalis large, ovate, with a conical horn of the same length, small scarce pores, and an internal frontal septum, composed of two crossed beams, a vertical and a horizontal. Thorax little larger than the cephalis, ovate, with irregular, small and scarce pores. (The two figures of Ehrenberg are either incomplete—in *Lithopera amblystauros*, the cephalic horn, and in *Lithopera oxystauros*, the basal part of the thorax, being broken off—or they belong to different Botryodea).

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·04 diameter.

*Habitat.*—Fossil in Barbados.

Genus 580. *Dicolocapsa*,[1] Haeckel, 1881, Prodromus, p. 433 (sensu emendato).

*Definition.*—Sethocapsida (vel Dicyrtida eradiata clausa) with a free cephalis, without apical horn.

The genus *Dicolocapsa* differs from the preceding *Sethocapsa* in the loss of the apical horn, and therefore bears to it the same relation that *Dictyocephalus* does to *Sethocyrtis*.

1. *Dicolocapsa microcephala*, n. sp. (Pl. 57, fig. 1).

Shell smooth, thin-walled, with distinct collar stricture. Cephalis small, subspherical, with small, crowded pores. Length of the two joints = 1 : 3, breadth = 1 : 3. Thorax also nearly spherical, three times as large as the cephalis, with small, irregularly scattered, circular pores, and much broader bars.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·09 diameter.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Dicolocapsa megacephala*, n. sp.

Shell smooth, thin-walled, with sharp collar stricture. Cephalis large, conical, obtuse. Length of the two joints = 5 : 9, breadth = 6 : 8. Thorax ovate, truncate, with hemispherical base. Pores of both joints equal, subregular, circular, about [illegible]d as the bars.

*Dimensions.*—Cephalis 0·05 long, 0·06 b[illegible]rax 0·09 long, 0·08 broad.

*Habitat.*—Central Pacific, Station 272 [illegible] 2600 fathoms.

3. *Dicolocapsa platycephala*, n. sp.

Shell papillate, thick-walled, with slight collar stricture. Cephalis flat, hemispherical, hyaline, without pores (or with few small pores). Length of the two joints = 2 : 11, breadth = 4 : 9. Thorax ovate, with small, regular, circular pores, half as broad as the bars.

*Dimensions.*—Cephalis 0·02 long, 0·04 broad; thorax 0·11 long, 0·09 broad.

*Habitat.*—Fossil in Barbados.

Genus 581. *Cryptocapsa*,[2] Haeckel, 1881, Prodromus, p. 433.

*Definition.*—Sethocapsida (vel Dicyrtida eradiata clausa) with a cephalis hidden in the thorax, without apical horn.

[1] *Dicolocapsa* = Two-jointed capsule; δίκωλος, κάψα.

[2] *Cryptocapsa* = Hidden capsule; κρυπτός, κάψα.

The genus *Cryptocapsa* differs from the preceding *Dicolocapsa*, its ancestral form, in the peculiar shape of the cephalis, which is nearly perfectly enclosed in the upper part of the inflated thorax. It has, therefore, to the latter the same relation as *Carpocanium* bears to *Anthocyrtis*.

1. *Cryptocapsa bacca*, n. sp.

Cephalis spherical, with small circular pores enclosed in the upper part of the thorax, which is ovate, smooth, and exhibits regular, circular pores, about as broad as the bars.

*Dimensions.*—Cephalis 0·03 diameter, thorax 0·15 long, 0·12 broad.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Cryptocapsa pila*, n. sp.

Cephalis spherical, with few small pores, enclosed in the upper part of the thorax, which is pear-shaped, spiny, and exhibits subregular, hexagonal pores, three times as broad as the bars. From each hexagon corner a small thorn arises.

*Dimensions.*—Cephalis 0·04 diameter, thorax 0·25 long, 0·17 broad.

*Habitat.*—Central Pacific, Station 269, depth 2900 fathoms.

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## Section III. TRICYRTIDA, Haeckel, 1881, Prodromus, p. 426, 434.

*Definition.*—Cyrtoidea trithalamia, with three-jointed shell, composed of cephalis, thorax, and abdomen, with two separating transverse constrictions, an upper collar, and a lower lumbar constriction.

*Synopsis of the Families and Subfamilies of Tricyrtida.*

| | | |
|---|---|---|
| Family LXV. Podocyrtida. Three radial apophyses. | Mouth open, | Theopilida. |
| | Mouth closed, | Theoperida. |
| Family LXVI. Phormocyrtida. Numerous radial apophyses. | Mouth open, | Theophormida. |
| | Mouth closed, | Theophænida. |
| Family LXVII. Theocyrtida. No radial apophyses. | Mouth open, | Theocorida. |
| | Mouth closed, | Theocapsida. |

## Family LXV. Podocyrtida, n. fam. (Pl. 67, 68, 71–73).

*Theopilida et Theoperida*, Haeckel, 1881, Prodromus, p. 435, 436.

*Definition.*—Tricyrtida triradiata. (Cyrtoidea with a three-jointed shell, divided by two transverse constrictions into cephalis, thorax, and abdomen, and bearing three radial apophyses.)

The family Podocyrtida, composed of the Theopilida and Theoperida of my Prodromus, comprises those Cyrtoidea in which the lattice-shell is three-jointed and triradial, bearing three external apophyses. The two subfamilies differ in the shape of the basal mouth, which in the Theopilida is a simple wide opening, in the Theoperida closed by a lattice-plate. The latter are derived from the former by development of this closing plate. The phylogenetic origin of the Podocyrtida may be found in the Tripocyrtida, from which they are derived by development of an abdomen. But there are also some forms, which may be derived directly from the Plectoidea, and the origin of some other forms seems to be doubtful.

The Podocyrtida represent one of the largest groups of Cyrtoidea, very rich in numerous species, which are partly very common and widely distributed. A large number of living and fossil species has already been described and figured by Ehrenberg, (1872, 1879, *loc. cit.*). These mainly belong to his genera *Podocyrtis*, *Pterocanium*, *Rhopalocanium*, *Lithornithium*, &c., and many of them are very characteristic and common forms, in which the triradial structure of the three-jointed shell is visible at first view. We distinguish here twenty genera and one hundred and fifty species. The majority have a shell with a simple wide open mouth (Theopilida, fourteen genera and one hundred and eighteen species), in the minority the mouth is closed by lattice-work (Theoperida, six genera and thirty-two species).

The three joints of the shell have in the majority of Podocyrtida such a proportion that the cephalis is the smallest, the abdomen the largest, and the thorax between them intermediate in size. The cephalis bears almost constantly an apical horn; this is rarely reduced or lost; sometimes two or more horns are developed. The three radial apophyses arise originally from the base of the cephalis, and may from this point run along the shell-wall embedded in the lattice-plate of the thorax and the abdomen. They leave the latter at very different points, and form either lateral wings or terminal feet, sometimes both together. They are either solid or latticed, sometimes also branched, and of very various shape. Often only the three terminal feet surrounding the mouth have remained, whilst the ribs have disappeared.

Many species of this large family are very variable and connected with other different species by numerous transitional forms; the distinction of the genera described is also often very difficult.

*Synopsis of the Genera of Podocyrtida.*

- **I. Subfamily Theopilida. (Podocyrtida aperta.)** — Terminal mouth of the shell a simple wide opening.
  - A. Three free limbs or wings on the thorax (partly also on the abdomen).
    - No free external appendages on the abdomen.
      - Three wings of the thorax solid.
        - Wings arising from the thorax, . 582. *Pterocorys.*
        - Three ribs enclosed in the wall of the thorax, . . 583. *Theopilium.*
        - Wings arising free from the collar stricture, . 584. *Corocalyptra.*
      - Three wings of the thorax latticed.
        - Wings not prolonged into the cephalis, 585. *Dictyoceras.*
        - Wings prolonged into the cephalis, 586. *Pteropilium.*
    - Free appendages on the abdomen.
      - Three ribs prolonged into three terminal feet.
        - Ribs and feet solid, 587. *Theopodium.*
        - Ribs and feet latticed, . . 588. *Pterocanium.*
      - Three free wings on the thorax. Numerous terminal feet.
        - Wings and feet solid, . . 589. *Pterocodon.*
        - Wings and feet latticed, . . 590. *Dictyocodon.*
  - B. Free appendages not on the thorax, only on the abdomen.
    - Abdomen with three ribs and three feet, . . 591. *Pleuropodium.*
    - Abdomen without lateral ribs, with three terminal feet.
      - Three feet solid, simple, . . 592. *Podocyrtis.*
      - Three feet solid, ramified, . 593. *Thyrsocyrtis.*
      - Three feet latticed, 594. *Dictyopodium.*
- **II. Subfamily Theoperida. (Podocyrtida clausa.)** — Terminal mouth of the shell closed by a lattice-plate.
  - Three lateral wings only on the thorax, .
    - Wings solid, . 595. *Lithornithium.*
    - Wings latticed, . 596. *Sethornithium.*
  - Three lateral wings beginning from the thorax and prolonged into the abdomen, . . . . . 597. *Theopera.*
  - Three wings only on the abdomen.
    - Shell spindle-shaped, with three lateral wings on the abdomen.
      - No horn on the basal pole, . . 598. *Rhopalocanium.*
      - Basal pole of the shell with a horn, 599. *Rhopalatractus.*
    - Shell three-sided pyramidal, with three terminal feet on the basal corners, . . . . 600. *Lithochytris.*

## Subfamily 1. THEOPILIDA, Haeckel, Prodromus, p. 435.

*Definition.*—Podocyrtida with the terminal mouth of the shell open (vel Tricyrtida triradiata aperta).

Genus 582. *Pterocorys*,[1] Haeckel, 1881, Prodromus, p. 435.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three simple, free lateral wings arising from the sides of the thorax.

The genus *Pterocorys*, comprising numerous and some very common species, may be one of the oldest and most primitive Theopilida, and is perhaps the common ancestral form of all Tricyrtida. It exhibits three free lateral wings, arising from the sides of the thorax, like *Lithomelissa* among the Dicyrtida, and may be derived directly from this genus by development of an abdomen. The latter is commonly cylindrical or ovate, with a wide open mouth, whilst the thorax is either campanulate or three-sided and pyramidal.

Subgenus 1. *Pterocyrtidium*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 531.

*Definition.*—Horn of the cephalis simple. Abdomen not prolonged into a narrow tube.

1. *Pterocorys campanula*, n. sp. (Pl. 71, fig. 3).

Shell campanulate, with two distinct strictures. Length of the three joints = 2 : 3 : 2, breadth = 2 : 4 : 6. Cephalis subovate, with a pyramidal horn of the same length. Thorax subconical, in the middle zone with three conical, horizontal wings, shorter than the cephalis, from which three thin ribs are decurrent to the mouth. Abdomen short and much dilated, with wide, truncate mouth. Pores nearly equal, small, subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·06, *c* 0·04; breadth, *a* 0·03, *b* 0·08, *c* 0·12.

*Habitat.*—Central Pacific, Stations 266 to 274, surface.

2. *Pterocorys carinata*, Haeckel.

*Eucyrtidium carinatum*, Haeckel, 1862, Monogr. d. Radiol., p. 322, Taf. vii. figs. 4–7.

Shell subovate, with two distinct strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis ovate, with a pyramidal horn of twice the length. Thorax campanulate, with three decurrent crests, from which in the lower part three small conical wings arise, shorter than the cephalis. Abdomen barrel-shaped, inflated, with wide, truncate mouth. Pores everywhere equal, small, regular, circular, quincuncial.

*Dimensions.*—Length of the three joints, *a* 0·25, *b* 0·05, *c* 0·075; breadth, *a* 0·25, *b* 0·09, *c* 0·1.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific; many stations, surface.

[1] *Pterocorys* = Helmet with wings; πτερόν, κόρυς.

3. *Pterocorys sabæ*, Häeckel.

*Pterocanium sabæ*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 299, Taf. x. fig. 17.

Shell campanulate or subconical, with two sharp strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 5. Cephalis subspherical, with a conical horn of the same length. Thorax subconical, in the lower third with three small, conical, little curved wings, shorter than the cephalis. Abdomen dilated towards the wide, truncate mouth. Pores subregular, circular, gradually increasing in size from the collar towards the mouth.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·06, *c* 0·08; breadth, *a* 0·02, *b* 0·08, *c* 0·09.

*Habitat.*—Indian Ocean, Zanzibar, 2200 fathoms (Pullen).

4. *Pterocorys columba*, n. sp. (Pl. 71, fig. 2).

Shell subovate, with two deep strictures. Length of the three joints = 2 : 5 : 4, breadth = 3 : 7 : 7. Cephalis hemispherical, with a curved conical horn of the same length. Thorax inflate, in the middle zone with three pyramidal downwardly divergent wings of nearly the same length. Abdomen short, inflate, little constricted towards the wide, truncate mouth. Pores all nearly equal, subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·04; breadth, *a* 0·03, *b* 0·07, *c* 0·07.

*Habitat.*—North Pacific, Station 237, surface.

5. *Pterocorys falcifera*, Haeckel.

*Pterocanium falciferum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 107, Taf. iv. fig. 15.
? *Pterocanium bibrachiatum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 106, Taf. iv. fig. 14.

Shell subovate, with two distinct strictures. Length of the three joints = 2 : 6 : 5 breadth = 3 : 9 : 10. Cephalis subspherical, with a conical horn of the same length. Thorax hemispherical, thick-walled, rough, with three stout triangular wings, which are about as long as the shell, and curved downwards, with upper convexity. Abdomen ovate, cylindrical, with wide, truncate mouth. Pores irregular, roundish, large and small intermingled; at the base of the abdomen (below the lumbar girdle) a circle of somewhat oblong, quadrangular pores.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·05; breadth, *a* 0·03, *b* 0·09, *c* 0·1.

*Habitat.*—Fossil in Tertiary rocks of Sicily, Grotte (Stöhr); Caltanisetta (Haeckel).

6. *Pterocorys aquila*, n. sp. (Pl. 71, fig. 5).

Shell ovate, with two deep strictures. Length of the three joints = 1 : 4 : 4, breadth = 1 : 8 : 6. Cephalis hemispherical, with a slender curved horn of three times the length. Thorax hemispherical, campanulate, spiny, prolonged above the lumbar girdle into three stout, three-sided prismatic

wings, which are longer than the shell, fenestrated at the base, and S-shaped, curved. Abdomen barrel-shaped, with wide, truncate mouth. Pores irregular, roundish, of very different sizes.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·08; breadth, *a* 0·03, *b* 0·16, *c* 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 7. *Pterocorys hirundo*, n. sp. (Pl. 71, fig. 4).

Shell slender, ovate, with two deep strictures. Length of the three joints = 1 : 4 : 4, breadth = 2 : 5 : 5. Cephalis hemispherical, with a large pyramidal horn longer than the half shell. Thorax conical, spiny, prolonged above the lumbar girdle into three slender, triangular, prismatic wings, which are about as long as the shell, and slightly curved downwards, with lower convexity. Abdomen inflated, with wide, truncate mouth, Pores irregular, roundish, of very different sizes.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·08; breadth, *a* 0·04, *b* 0·1, *c* 0·1.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 8. *Pterocorys barbadensis*, Haeckel.

*Pterocanium barbadense*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xvii. fig. 6.

*Pterocyrtidium barbadense*, Bütschli, 1882, Zeitschr. f. wiss. Zool., Bd. xxxvi., Taf. xxxiii. fig. 29, *a*, *b*.

Shell slender, smooth, with two slight strictures. Length of the three joints = 1 : 3 : 4, breadth = 2 : 4 : 4. Cephalis hemispherical, with a stout pyramidal horn of twice the length. Thorax campanulate-conical, in the lower half with three divergent, angular wings, which are slightly curved downwards, and as long as the thorax. Abdomen cylindrical, with wide, truncate mouth. Pores small, subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·07; breadth, *a* 0·04; *b* 0·07, *c* 0·07.

*Habitat.*—Fossil in Barbados.

### 9. *Pterocorys apis*, Haeckel.

*Pterocodon apis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xix. fig. 3.

Shell slender, smooth, with two distinct strictures. Length of the three joints = 1 : 2 : 6, breadth = 2 : 3 : 4. Cephalis hemispherical, with a curved, conical horn of three times the length. Thorax very small, with three nearly horizontal, conical wings, which are slightly curved downwards, and twice as long as the thorax. Abdomen cylindrical, three times as long as the thorax, with wide, truncate mouth. Pores small, subregular, circular. Differs from all other species in the very small size of the thorax; the abdomen is broken off in Ehrenberg's figure.

*Dimensions.*—Length of the three joints, *a* 0·15, *b* 0·02, *c* 0·06; breadth, *a* 0·02, *b* 0·03, *c* 0·04.

*Habitat.*—Cosmopolitan; Atlantic, Pacific, many stations; also fossil in Barbados.

10. *Pterocorys melitta*, Haeckel.

*Rhopalocanium ornatum*, Bury, 1862, Polycystins of Barbados, Taf. vi. fig. 4.

Shell slender, smooth, with two deep strictures. Length of the three joints = 1 : 1 : 3, breadth = 1 : 2 : 2. Cephalis subspherical, with a pyramidal horn of twice the length. Thorax broad and short, loaf-shaped, with three conical wings, which are horizontally expanded, and half as long as the shell. Abdomen cylindrical, with wide, truncate mouth. Pores small, subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·03, *c* 0·09; breadth, *a* 0·03, *b* 0·06, *c* 0·06.

*Habitat.*—Fossil in Barbados.

11. *Pterocorys turgida*, Haeckel.

*Lychnocanium turgidum*, Ehrenberg, 1885, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. vii. fig. 6.

Shell thick-walled, pear-shaped, smooth, with sharp collar stricture. The lumbar stricture is not distinct externally, but is represented by a broad, internal, annular septum. Length of the three joints = 1 : 6 : 3, breadth = 2 : 7 : 6. Cephalis hemispherical, with a stout pyramidal horn of the same length. Thorax and abdomen together pear-shaped, inflated. Immediately above the lumbar stricture three stout, conical, lateral wings, as long as the cephalis, arise. Mouth very small, about as broad as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·12, *c* 0·06; breadth, *a* 0·03, *b* 0·13, *c* 0·12.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Pterosyringium*, Haeckel.

*Definition.*—Horn of the cephalis simple. Abdomen prolonged into a narrow cylindrical tube.

12. *Pterocorys tubulosa*, n. sp. (Pl. 68, fig. 6).

*Pterosyringium tubulosum*, Haeckel, 1879, Atlas, *loc. cit.*

Shell thick-walled, rough, with two slight strictures. Length of the three joints = 1 : 4 : 4, breadth = 1 : 3 : 1. Cephalis hemispherical, with a conical horn of the same length. Thorax ovate, in the upper half with three ribs, arising into short, triangular, slightly prominent wings. Abdomen prolonged into a cylindrical, narrow tube of the same length as the thorax. Terminal mouth very narrow. Pores subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·12, *c* 0·12; breadth, *a* 0·03, *b* 0·09, *c* 0·03.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

13. *Pterocorys pipetta*, n. sp.

Shell thin-walled, smooth, with two slight strictures. Length of the three joints = 1 : 6 : 3, breadth = 1 : 3 : 1. Cephalis ovate, with a conical horn of twice the length. Thorax ovate, in the middle zone with three conical wings of the same length, curved slightly downwards (like those of *Pterocorys columba*, Pl. 71, fig. 2). Abdomen constricted into a cylindrical tube half as long as the thorax, with narrow mouth. Pores subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·12, *c* 0·06; breadth, *a* 0·02, *b* 0·06, *c* 0·02.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Subgenus 3. *Pterocorythium*, Haeckel.

*Definition.*—Horn of the cephalis double or multiple. Abdomen not prolonged into a narrow tube.

14. *Pterocorys rhinoceros*, n. sp. (Pl. 71, fig. 1).

Shell very delicate and thin-walled, with two sharp strictures. Length of the three joints = 2 : 10 : 3, breadth, 3 : 11 : 9. Cephalis obtuse, conical, with two divergent, conical horns of equal length. Thorax triangular, pyramidal; from its three edges there arise on the middle joint three conical descending wings (little larger than the horns), and from the base of each wing descend two divergent crests, forming at the sides of the pyramid three rounded lobes. Abdomen short, cylindrical, with wide, truncate mouth. Network of the whole shell very delicate, with very small and numerous, regular, circular, hexagonally-framed pores.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·03; breadth, *a* 0·03, *b* 0·11, *c* 0·09.

*Habitat.*—Central Pacific, Stations 270 to 274, surface, and in various depths.

15. *Pterocorys prismatica*, n. sp.

Shell very delicate and thin-walled throughout, with fine fenestration similar to that of the preceding species, but differing from it in the form of the abdomen, which is much larger, three-sided and prismatic; three edges of the prism decurrent from the bases of the three short wings. Length of the three joints = 1 : 4 : 5, breadth = 2 : 6 : 6. No lobes at the thorax. Mouth wide open, truncate, triangular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·1; breadth, *a* 0·04, *b* 0·12, *c* 0·12.

*Habitat.*—South Pacific, Station 288, surface.

16. *Pterocorys tricornis*, n. sp.

Shell spiny, with two deep strictures. Length of the three joints = 1 : 5 : 3, breadth = 1 : 7 : 5. Cephalis subspherical, with three stout, pyramidal, divergent horns, which are three times as long,

and bear three serrated edges. Thorax three-sided pyramidal, spiny; its three edges prolonged at the girdle into three stout, triangular, prismatic wings of the same length, little curved. Abdomen short, cylindrical, with wide open, truncate mouth. Pores irregular, polygonal, roundish.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·06; breadth, *a* 0·03, *b* 0·14, *c* 0·1.

*Habitat.*—North Pacific, Station 244, surface.

17. *Pterocorys zittelii*, Haeckel.

*Pterocyrtidium zittelii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. pp. 531, 540, Taf. xxxiii. figs. 28, *a*, *b*.

Shell thin-walled, rough, with two slight strictures. Length of the three joints = 2 : 5 : 7, breadth = 3 : 5 : 5. Cephalis hemispherical, armed with a very large, prismatic, vertical horn, which is half as long as the shell, and at its base surrounded by several (three to five) shorter, upwardly diverging horns. Thorax campanulate, in the upper half with three short, downwardly diverging, conical wings. Abdomen subcylindrical, with wide, truncate mouth. Pores small, subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·07; breadth, *a* 0·03, *b* 0·05, *c* 0·05.

*Habitat.*—Fossil in Barbados.

18. *Pterocorys macroptera*, n. sp.

Shell thin-walled, smooth, with two slight strictures. Length of the three joints = 1 : 3 : 2, breadth = 1 : 4 : 3. Cephalis hemispherical, armed with two larger and six to eight smaller, conical, divergent horns of different lengths. Thorax three-sided pyramidal; its three edges prolonged into three very large diverging wings, which are slender, three-sided, prismatic, and nearly twice as long as the shell. Abdomen short, cylindrical, with wide, truncate mouth. Pores irregular, roundish, in the middle part of the shell (on both sides of the girdle) much larger than in the upper and lower part.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·06; breadth, *a* 0·04, *b* 0·12, *c* 0·1.

*Habitat.*—South Atlantic, Station 335, surface.

Genus 583. *Theopilium*,[1] Haeckel, 1881, Prodromus, p. 435.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three lateral ribs enclosed in the wall of the thorax, without free lateral or terminal appendages.

The genus *Theopilium* differs from all the other Theopilida in the absence of free external appendages; it has neither lateral wings nor terminal feet, but three divergent ribs are enclosed in the wall of the thorax. It agrees in this character with the Dicyrtid *Lamprodiscus*, and may be derived directly from this by development of an abdomen.

[1] *Theopilium* = Divine hat; *θεός*, *πίλιον*.

1. *Theopilium tricostatum*, n. sp. (Pl. 70, fig. 6).

Shell flatly conical, smooth. Length of the three joints = 1 : 4 : 2, breadth = 2 : 6 : 10. Cephalis subspherical, with a thin oblique horn of the same length. Thorax with three stout ribs in its wall, and with subregular, hexagonal pores increasing in size towards the girdle. Abdomen flatter than the thorax, without ribs, nearly horizontal, with subregular, square pores, disposed in four to six concentric, subcircular series of different sizes; decreasing in size towards the wide open mouth. Seen from the side, this species resembles *Corocalyptra agnesæ*, (Pl. 59, fig. 3).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·04; breadth, *a* 0·03, *b* 0·12, *c* 0·2.

*Habitat.*—Central Pacific, Stations 260 to 274, surface.

2. *Theopilium triradiatum*, n. sp.

Shell flatly conical, smooth, in general of the same form as, and with similar fenestration to, the preceding species, but different in the proportions. Length of the three joints = 1 : 4 : 2, breadth = 2 : 4 : 6. Cephalis hemispherical, with two divergent, thin horns of the same length. Thorax more elevated, about as high as broad. The three divergent ribs are not limited to the thorax, but prolonged through the whole abdomen, the outline of which is a prolongation of that of the thorax.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·1, *c* 0·05; breadth, *a* 0·05, *b* 0·1, *c* 0·15.

*Habitat.*—Tropical Atlantic, Station 347, surface.

3. *Theopilium cranoides*, Haeckel.

*Eucyrtidium cranoides*, Haeckel, 1862, Monogr. d. Radiol., p. 320, Taf. vii. figs. 1–3.

Shell campanulate-conical, smooth. Length of the three joints = 2 : 5 : 4, breadth = 3 : 9 : 10. Cephalis ovate, with a straight, excentric, prismatic horn of the same length. The campanulate thorax is separated from it by no external collar stricture, but by an internal septum. From the base of the horn arise three divergent radial ribs, running in the wall of the two first joints to the lumbar stricture (*loc. cit.*, Taf. vii. fig. 3). Abdomen short and wide, without ribs. Pores rather large, regular, circular, quincuncial, in the cephalis smaller. Central capsule four-lobed.

*Dimensions.*—Length of the three joints, *a* 0·027, *b* 0·054, *c* 0·047; breadth, *a* 0·03, *b* 0·09, *c* 0·1.

*Habitat.*—Mediterranean (Messina), surface.

## Genus 584. *Corocalyptra*,[1] n. gen.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three simple, free, lateral wings, arising from the collar stricture between cephalis and thorax.

The genus *Corocalyptra* comprises a small number of very elegant hat-shaped Tricyrtida, which resemble greatly *Eucecryphalus* among the Dicyrtida. As in the

[1] *Corocalyptra* = Coif or hood of a girl; κόρη, καλυπτρα.

latter, three free, radial spines, or simple wings, corresponding to the three basal feet of *Cortina*, arise from the collar stricture between the small hemispherical cephalis and the large, flatly conical thorax. *Corocalyptra* differs from *Eucecryphalus*, its ancestral form, in the development of a flat and broad abdomen, which is a prolongation of the thorax, and may be compared to the brim of a hat.

1. *Corocalyptra agnesæ*, n. sp. (Pl. 59, fig. 3).

Shell flatly conical or hat-shaped. Length of the three joints = 1 : 4 : 2, breadth = 2 : 8 : 12. Cephalis hemispherical, with an oblique, small, conical horn of the same length. From the slight collar stricture arise three slender, conical feet of equal length, twice as long as the apical horn, nearly horizontally divergent. Lateral outline of the conical thorax straight, of the flatter abdomen convex; the smooth margin of the abdomen turned inwards. Network delicate, with subregular, hexagonal pores.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·04; breadth, *a* 0·03, *b* 0·15, *c* 0·24.

*Habitat.*—Central Pacific, Station 270, surface.

2. *Corocalyptra elisabethæ*, n. sp. (Pl. 59, fig. 10).

Shell flatly conical, hat-shaped, very similar to the preceding species, but with different proportions. Length of the three joints = 1 : 4 : 2; breadth = 1 : 7 : 10. Cephalis very small, with an oblique horn of the same length. The three feet are of different sizes, the caudal odd foot being twice as long as the two lateral, which are equal to the horn. Lateral outline of the campanulate thorax convex, of the flatter abdomen less convex. Margin of the mouth flat.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·06, *c* 0·03; breadth *a* 0·02, *b* 0·14, *c* 0·2.

*Habitat.*—Tropical Atlantic, Station 347, surface.

3. *Corocalyptra emmæ*, n. sp. (Pl. 59, fig. 4).

Shell nearly conical, hat-shaped. Length of the three joints = 1 : 3 : 1, breadth = 1 : 5 : 7. Cephalis hemispherical, with a straight horn of the same length. Feet of the collar larger than in the preceding species, the two lateral smaller being directed upwards, the larger odd caudal downwards. Thorax slightly campanulate; its hexagonal meshes two to four times as large as those of the short, convex abdomen, which is turned inwards.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·09, *c* 0·03; breadth, *a* 0·025, *b* 0·13, *c* 0·17.

*Habitat.*—Central Pacific, Station 272, surface.

4. *Corocalyptra margarethæ*, n. sp.

Shell nearly conical, hat-shaped, very similar to the preceding species, but with much more delicate hexagonal network, with thread-like bars. Length of the three joints = 1 : 7 : 2, breadth =

1 : 10 : 12. Cephalis hemispherical, with six bristle-shaped spines of half the length of the shell; three horns divergent upwards, and three alternating feet divergent downwards. Thorax nearly conical. Abdomen flatter.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·1, *c* 0·03; breadth, *a* 0·02, *b* 0·15, *c* 0·18.

*Habitat.*—North Pacific, Station 236, surface.

### 5. *Corocalyptra ludovicæ*, n. sp.

Shell flatly campanulate or hat-shaped. Length of the three joints = 1 : 4 : 3, breadth = 2 : 7 : 10. Cephalis hemispherical, with six bristle-shaped spines, about one-fourth to one-third as long as the shell; three horns diverging upwards, and three alternate feet diverging downwards. Thorax nearly conical. Abdomen much larger than in all preceding species, inflated, with convex, lateral outline; its mouth-edge curved inwards. The network is much finer than in the similar *Corocalyptra emmæ* (Pl. **59**, fig. 4), and the abdomen is relatively twice as long and broad.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·06; breadth, *a* 0·04, *b* 0·14, *c* 0·2.

*Habitat.*—Central Pacific, Station 271, surface.

## Genus 585. *Dictyoceras*,[1] Haeckel, 1862, Monogr. d. Radiol., p. 333

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three latticed free lateral wings on the sides of the thorax, which are not prolonged into the cephalis.

The genus *Dictyoceras* and the following *Pteropilium* agree with the two preceding genera in the possession of three lateral wings on the sides of the thorax; but whilst these in the latter are simple solid spines, they are in the former vertical fenestrated plates. *Dictyoceras* may be derived from *Pterocorys* by development of a vertical lattice-plate between the thorax and the three free lateral spines arising from it.

### 1. *Dictyoceras insectum*, n. sp. (Pl. **71**, figs. 6, 7).

Shell with two distinct strictures. Length of the three joints = 1 : 3 : 2, breadth = 2 : 4 : 3. Cephalis hemispherical, with a slender pyramidal horn of twice the length. Thorax subspherical, in the upper half with three divergent lattice-wings of the same length, each of which represents a slender, fenestrated, three-sided pyramid. Abdomen subovate, with wide, truncate mouth (in the figured specimen broken off). Pores circular, small, of different sizes.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·055, *c* 0·04; breadth, *a* 0·035, *b* 0·08, *c* 0·06.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

[1] *Dictyoceras* = Reticulated horn; δίκτυον, κέρας.

2. *Dictyoceras formica*, n. sp. (Pl. 71, fig. 8).

Shell with obliterate collar, but deep lumbar stricture. Length of the three joints = 1 : 2 : 3, breadth = 2 : 5 : 4. Cephalis conical, with an oblique curved horn of the same length. Thorax with three vaulted swellings between the three prominent, diverging lattice-wings, the apex of which is prolonged downwards into a solid curved spine, half as long as the inflated abdomen. Mouth little constricted. Pores irregular, roundish, of different sizes.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·06 ; breadth, *a* 0·03, *b* 0·1, *c* 0·09.

*Habitat.*—North Atlantic, Station 353, surface.

3. *Dictyoceras melitta*, n. sp. (Pl. 71, fig. 9).

Shell with two deep strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 6 : 5. Cephalis subspherical, with two conical divergent horns of the same length. Thorax three-sided pyramidal, the three edges prolonged into three lattice-wings of the same form, with short, terminal spines. Abdomen inflated, subovate, with constricted mouth. Pores small, regular, circular, of equal size, with very thin bars.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·12 ; breadth, *a* 0·04, *b* 0·18, *c* 0·15.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

4. *Dictyoceras bombus*, n. sp. (Pl. 71, fig. 10).

Shell with deep collar, but evanescent lumbar stricture. Length of the three joints = 1 : 5 : 3, breadth = 1 : 6 : 7. Cephalis subspherical, with a conical horn of the same length. Thorax campanulate, with three short and broad, triangular lattice-wings, the upper edge of which is nearly horizontal, the lower nearly vertical and decurrent from the height of the collar to the lumbar stricture. Abdomen inflated, with constricted mouth of half the breadth. Pores small, subregular, circular, of nearly equal size.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·06 ; breadth, *a* 0·025, *b* 0·12, *c* 0·14.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

5. *Dictyoceras virchowii*, Haeckel.

*Dictyoceras virchowii*, Haeckel, 1862, Monogr. d. Radiol., p. 333, Taf. viii. figs. 1–5.
*Lithornithium dictyoceras*, Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, 1860, p. 840.

Shell with two distinct strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 5 : 6, Cephalis subspherical, with an oblique curved horn of the same length. Thorax conical, with three broad, triangular lattice-wings different in size and direction, two of which are directed outwards, the third downwards—each terminated by a strong spine. Abdomen oblique, inflated, with wide open, truncate mouth. On the shell surface some few conical spines are scattered. Pores irregular,

roundish, of different sizes. On the peculiar symmetry of this remarkable form, compare the detailed description in my Monograph.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·08 ; breadth, *a* 0·02, *b* 0·1, *c* 0·12.

*Habitat.*—Mediterranean, Messina, surface.

Genus 36. *Pteropilium*,[1] Haeckel, 1881, Prodromus, p. 435.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three latticed free lateral wings on the sides of the thorax, prolonged into the horn of the cephalis in the form of three vertical, free cephalic wings.

The genus *Pteropilium* differs from the preceding closely allied *Dictyoceras* in the development of three free, vertical, latticed cephalic wings, expanded between the apical horn of the cephalis and the three wings of the thorax; they may be direct prolongations of the latter. *Pteropilium*, however, may also be derived directly from the Dicyrtida *Callimitra* or *Clathrocorys* by development of an abdomen. All these interesting forms are closely allied to the Plectoidea.

Subgenus 1. *Clathropilium*, Haeckel, 1881, Prodromus, p. 435.

*Definition.*—Thorax completely latticed, without three larger lateral holes between the three wings.

1. *Pteropilium stratiotes*, n. sp. (Pl. 70, figs. 9, 10).

Shell thin-walled, with two deep strictures. Length of the three joints = 1 : 5 : 4, breadth = 2 : 6 : 9. Cephalis hemispherical, with a vertical, straight, prismatic horn of three times the length. Thorax inflated, oblique, with three slender, nearly straight, widely divergent ribs, beginning from the collar stricture and united in its centre with the centripetal prolongation of the horn. The basal half of the three ribs is enclosed in the thorax wall, whilst the distal half lies outside it, and is connected with its lower half only by two divergent, reticulated wings. The upper edge of the ribs is connected with the occipital horn by a vertical, loosely reticulated, triangular wing. Abdomen half as long as the thorax, also of irregular and oblique form, with knee-shaped outline and a wide, truncate mouth. Network with irregular polygonal, for the most part quadrangular, meshes, separated by thin bars and forming irregular transverse rows. Some stronger, vein-like ribs ramify in the wall, diverging towards the mouth.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·1, *c* 0·08 ; breadth, *a* 0·04, *b* 0·12, *c* 0·18.

*Habitat.*—Central Pacific, Station 271, surface.

[1] *Pteropilium* = Small hat with wings ; πτερόν, πίλιον.

2. *Pteropilium hoplites*, n. sp.

Shell in the general form and in the irregular, quadrangular fenestration similar to the preceding species, but more heavy and with different proportions. Length of the three joints = 1 : 6 : 4, breadth = 2 : 6 : 8. Cephalis twice as broad as in *Pteropilium stratiotes*. Thorax more slender and subovate. Abdomen truncate, conical, gradually dilated, with straight, non-geniculate outline. Network coarser, with larger square meshes and thicker bars.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·12, *c* 0·08; breadth, *a* 0·05, *b* 0·12, *c* 0·16.

*Habitat.*—Central Pacific. Station 272, depth 2600 fathoms.

*Pteropilium eques*, n. sp.

Shell in the general form and in the irregular, quadrangular fenestration similar to those of the two preceding species, but more slender and with different proportions. Length of the three joints = 1 : 2, breadth = 2 : 4 : 4. Cephalis flatter. Thorax subconical, also flatter. Abdomen short, cylindrical, with straight outline. Network looser than in the two preceding species, with larger square meshes and thinner bars.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·06; breadth *a* 0·06, *b* 0·12, *c* 0·12.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Subgenus 2. *Arachnopilium*, Haeckel, 1881, Prodromus, p. 435.

*Definition.*—Thorax with three large lateral holes between the three latticed wings.

4. *Pteropilium clathrocanium*, n. sp. (Pl. 64, fig. 7).

*Arachnopilium clathrocanium*, Haeckel, Prodromus, 1881, p. 435.

Shell very delicate, with two deep strictures. Length of the three joints = 2 : 4 : breadth = 2 : 5. Cephalis subspherical, with circular, polygonally-framed pores, and a centra three-sided pyramidal, apical horn of twice the length. Thorax three-sided pyramidal, wit three large, holes between three prominent latticed wings. From its surface arises a ver delicate, arac l network with irregular, polygonal meshes, enveloping also the entire cephali Abdomen wi short, as long as the cephalis, and half as broad as the distance of the wing twice as broa e constricted mouth.

*Dimensio* ngth of the three joints, *a* 0·04, *b* 0·08, *c* 0·04; breadth, *a* 0·05, *b* 0·2, *c* 0·1.

*Habitat.*— Pacific, Station 271, depth 2425 fathoms.

Genus. 587. *Theopodium*,[1] Haeckel, 1881, Prodromus, p. 435.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three divergent solid ribs, which lie in the wall of the thorax and the abdomen, and are prolonged into three solid terminal feet.

The genus *Theopodium* and the following closely allied *Pterocanium* differ from the preceding four genera in the development of the three radial rods or the primary cortinar spines, which are not free lateral wings, but longitudinal ribs enclosed in the wall of the thorax and abdomen, and prolonged over the basal mouth into three free terminal feet. These are solid in *Theopodium*, which, therefore, corresponds to *Lychnocanium* among the Dicyrtida.

1. *Theopodium tricostatum*, n. sp. (Pl. 97, fig. 14).

Shell three-sided pyramidal, thorny, with two distinct strictures. Length of the three joints = 1 : 2 : 2, breadth = 1 : 3 : 4. Cephalis hemispherical, with a stout conical horn of the same length. Thorax with regular, circular, hexagonally-framed pores. Abdomen with irregular, roundish pores of very different sizes. From the middle part of the thorax arise the three prominent, wing-like edges of the pyramid, which are prolonged over its wide mouth into three stout, pyramidal, divergent feet about as long as the thorax, with dentate, lamellar edges.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·06; breadth, *a* 0·04, *b* 0·09, *c* 0·12.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

2. *Theopodium pyramidale*.

Shell three-sided pyramidal, without external strictures, but with two broad internal girdles. Length of the three joints = 1 : 2 : 6, breadth = 2 : 4 : 8. Cephalis with a thick horn of the same length, conical thorax with very small, regular, circular pores. Abdomen with irregular, roundish pores of very different sizes. From the collar stricture arise the three rectilinear edges of the pyramid, which are prolonged over its wide-open mouth into three stout, divergent, pyramidal feet about as long as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·12; breadth, *a* 0·04, *b* 0·075, *c* 0·15.

*Habitat.*—Fossil in Barbados.

Genus 588. *Pterocanium*,[2] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theopilida (vel Tricyrtida triradiat[illegible] bs, which run along the thorax and abdomen, and are prolonged in[illegible]ree latticed rminal feet.

[1] *Theopodium* = Divine foot; θεός, πόδιον.

[2] *Pterocanium* = Basket with wings; πτερόν, κάνεον.

The genus *Pterocanium* differs from the preceding *Theopodium* in the fenestration of the three terminal feet, which are basal prolongations of the three radial ribs, enclosed in the wall of the thorax and the abdomen. Often also these ribs are partly or wholly fenestrated. It corresponds to *Lychnodictyum* among the Dicyrtida, and may be derived from this by development of an abdomen. The latter forms sometimes three concave bays, at other times three convex lobes between the three latticed feet.

### Subgenus 1. *Pterocanarium*, Haeckel.

*Definition.*—Free basal edge of the abdomen between the three feet concave, forming three shallower or deeper bays between them.

#### 1. *Pterocanium proserpinæ*, Ehrenberg.

*Pterocanium proserpinæ*, Ehrenberg, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, 1872, p. 299, Taf. xi. fig. 22.

*Pterocanium proserpinæ*, Haeckel, 1862, Monogr. d. Radiol., p. 332.

Shell campanulate, rough. Length of the three joints = 1 : 4 : 2, breadth 1 : 5 : 6. Cephalis subspherical, with a triangular-pyramidal vertical horn of thrice the length. Thorax hemispherical, without prominent swellings. Abdomen shorter, with three concave basal bays. Pores in the thorax and abdomen nearly equal, subregular, circular. Feet from the girdle (or the lumbar stricture) little divergent, nearly straight.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·04; breadth, *a* 0·3, *b* 0·1, *c* 0·12.

*Habitat.*—Mediterranean, Candia, Spratt, depth 1100 fathoms.

#### 2. *Pterocanium gravidum*, n. sp., (Pl. 73, fig. 3).

Shell campanulate, nearly three-sided pyramidal, smooth. Length of the three joints = 1 : 4 : 3, breadth = 1 : 6 : 10. Cephalis subspherical, with a pyramidal straight horn of twice the length, Thorax hemispherical, without prominent swellings. Abdomen shorter, with three concave basal bays; its network prolonged to the ends of the feet. Pores in the thorax and abdomen of nearly equal size, irregular, roundish. Feet from the girdle strongly divergent, with convex back.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·075, *c* 0·06; breadth, *a* 0·02, *b* 0·12, *c* 0·2.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

#### 3. *Pterocanium orcinum*, n. sp. (Pl. 73, fig. 2).

Shell campanulate, nearly three-sided pyramidal, covered with conical spines. Length of the three joints = 1 : 4 : 3, breadth = 1 : 5 : 6. Cephalis hemispherical, with a conical horn of the same length. Thorax without prominent swellings, with subregular, circular pores. Abdomen

shorter, with three concave basal edges and irregular, polygonal pores. Feet from the girdle strongly divergent, nearly straight.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·06; breadth, *a* 0·03, *b* 0·1, *c* 0·12.

*Habitat.*—Central Pacific, Station 263 to 274, depth 2350 to 2925 fathoms.

4. *Pterocanium contiguum*, Ehrenberg.

*Pterocanium contiguum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, Taf. xvii. fig. 7.

Shell three-sided pyramidal, smooth. Length of the three joints = 1 : 3 : 2, breadth = 1 : 4 : 6. Cephalis small, subspherical, with a large conical horn three times the length. Thorax and abdomen with small, regular, circular pores of equal size, densely crowded together, with thin bars. Abdomen shorter, with three concave basal edges. Feet very thick, straight, from the girdle strongly divergent.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·05, *c* 0·025; breadth *a* 0·02, *b* 0·08, *c* 0·12.

*Habitat.*—Fossil in Barbados.

5. *Pterocanium pyramis*, n. sp. (Pl. 68, fig. 7).

Shell three-sided pyramidal, smooth. Length of the three joints = 1 : 4 : 3, breadth = 2 : 4 : 6, Cephalis hemispherical, with a conical horn of the same length. Thorax campanulate, with fifteen to twenty prominent longitudinal ribs, separating as many rows of regular, circular pores. Abdomen shorter, with three concave basal bays, and irregular, roundish pores. Feet very strong, pyramidal, straight, gradually divergent from the girdle.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·08, *c* 0·06; breadth, *a* 0·04, *b* 0·08, *c* 0·12.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

6. *Pterocanium virgineum*, n. sp. (Pl. 73, fig. 6).

Shell nearly three-sided pyramidal, smooth. Length of the three joints = 1 : 4 : 8, breadth 2 : 6 : 9. Cephalis hemispherical, with a conical straight horn three times the length. Thorax campanulate, with three slight swellings between the three knee-shaped ribs, and with regular circular pores. Abdomen longer, with three concave basal bays, and with very small and numerous pores (much smaller than those of the thorax). At both sides of the three prominent abdominal crests, two rows of larger, nearly square pores occur. Feet slender, nearly straight, divergent.

*Dimensions.*—Length of the three joints, *a* 0·15, *b* 0·06, *c* 0·12; breadth, *a* 0·03, *b* 0·09, *c* 0·14.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

7. *Pterocanium prætextum*, Haeckel.

*Lychnocanium prætextum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. x. fig. 2.

Shell nearly three-sided prismatic, smooth. Length of the three joints = 1 : 2 : 1, breadth = 1 : 4 : 4. Cephalis subspherical, with a straight, conical horn of three times the length. Thorax

campanulate with three slight swellings between the three knee-shaped ribs, ..... ..... egular, circular pores. Abdomen smaller, with three deep concave basal bays, and with irregular, roundish pores. Feet longer than the shell, slender, pyramidal, straight, parallel.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·02; breadth, *a* 0·02, *b* 0·07, *c* 0·07.

*Habitat.*—Indian Ocean, Ceylon (Haeckel); Zanzibar (Pullen).

8. *Pterocanium depressum*, Haeckel.

*Lychnocanium depressum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. x. fig. 1.

Shell (including the feet) nearly three-sided prismatic, rough. Length of the three joints = 1 : 2 : 1, breadth = 1 : 6 : 6. Cephalis subspherical, with a conical horn of the same length. Thorax a very flat and broad triangular pyramid, three times as broad as long. Abdomen smaller, with three deep, parabolic, concave bays. Pores irregular, roundish. Feet longer than the shell, slender, pyramidal, straight, parallel.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·02; breadth, *a* 0·025, *b* 0·12, *c* 0·12.

*Habitat.*—Indian Ocean, Zanzibar, depth 2200 fathoms (Pullen).

9. *Pterocanium campanella*, Haeckel.

*Lychnocanium campanella*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 297, Taf. viii. fig. 12.

*Podocyrtis campanella*, Ehrenberg, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 769.

Shell campanulate, smooth, with three high fenestrated crests and deep collar stricture. Length of the three joints = 1 : 3 : 1, breadth = 1 : 4 : 3. Cephalis subspherical, with a slender horn of the same length. Thorax inflated, campanulate, with three vaulted swellings between the three curved ribs. Abdomen short, with three semicircular bays between the three feet. Pores of the whole shell regular, circular, small, and numerous. Feet broad, triangular, shorter than the thorax, with convex back and convergent ends.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·06, *c* 0·2; breadth, *a* 0·02, *b* 0·08, *c* 0·07.

*Habitat.*—Western Tropical Pacific, Philippine Sea, 3300 fathoms (Brooke).

10. *Pterocanium tricolpum*, n. sp. (Pl. 73, fig. 1).

Shell nearly three-sided prismatic, smooth, with three high fenestrated crests and two deep strictures. Length of the three joints = 1 : 3 : 2, breadth = 1 : 5 : 5. Cephalis subspherical, with an oblique, conical horn of the same length. Thorax inflated, with three highly vaulted bosoms between the three high crests, and with subregular, circular pores. Abdomen shorter, with three concave (or nearly rectangular, square) basal bays between the three feet, and with irregular, roundish pores, three to four pairs of larger pores occurring at the sides of the base of the feet. Feet nearly as long as the shell, with fenestrated bases, nearly straight and parallel; somewhat convergent, with convex back. (Often the concave bays between the three feet are not square, as in the specimen figured, but semi-

circular.) The ends of the feet are sometimes strongly convergent. The vaultings of the three swellings and the reticulation are also variable; the whole form is often irregular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·04; breadth, *a* 0·025, *b* 0·1, *c* 0·1.

*Habitat.*—Cosmopolitan; Atlantic, Pacific; many stations, surface.

## Subgenus 2. *Pterocanidium*, Haeckel.

*Definition.*—Free basal edge of the abdomen between the three feet convex, forming three rounded or semicircular prominent lobes between them.

### 11. *Pterocanium eucolpum*, n. sp. (Pl. 73, fig. 4).

*Dictyopodium eucolpum*, Haeckel, 1881, Prodromus et Atlas.

Shell about triangular-prismatic, with two deep strictures, smooth. Length of the three joints = 1 : 3 : 3, breadth = 1 : 3 : 4. Cephalis subspherical, with a conical, oblique horn of the same length. Thorax inflated, with three hemispherical swellings between the three high crests, and with subregular, hexagonal pores. Abdomen longer, with much smaller, irregular, roundish pores, forming three broad, convex lobes between the three feet. (In the figured specimen the lobes were not fully developed, and extremely thin below the line parallel to the edge. In another specimen, found afterwards in the same locality, the three lobes were much larger, semicircular, and reached almost to the basal plane of the ends of the feet by reason of their convexity.) Feet strong, with slightly convex back, divergent.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·1; breadth, *a* 0·03, *b* 0·09, *c* 0·12.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 12. *Pterocanium bicorne*, n. sp. (Pl. 73, fig. 5).

*Dictyopodium bicorne*, Haeckel, 1881, Prodromus et Atlas.

Shell nearly three-sided pyramidal, slender, smooth. Length of the three joints = 1 : 2 : 2, breadth = 1 : 4 : 4. Cephalis hemispherical, with two oblique, conical horns of nearly equal length. Thorax nearly hemispherical, with slightly prominent crests, and with subregular, hexagonal pores. Abdomen of about the same length, with much smaller, irregular, roundish pores, forming three convex, nearly circular lobes between the three large divergent feet. These are slender, three-sided pyramidal, longer than the shell, fenestrated at the thickened base, with some rows of larger pores; their back is slightly concave.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·04; breadth, *a* 0·02, *b* 0·08, *c* 0·09.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

13. *Pterocanium trilobum*, Haeckel.

*Dictyopodium trilobum*, Haeckel, 1882, Monogr. d. Radiol., p. 340, Taf. viii. figs. 6–10.

Shell three-sided pyramidal, nearly tetrahedral, covered with conical spines. Length of the three joints = 1 : 4 : 2, breadth = 1 : 6 : 10. Cephalis hemispherical, with a large conical horn (as long as the thorax). Thorax tetrahedral, with little prominent crests. Abdomen forming three semicircular, convex lobes between the three feet, half as long as the thorax, with the same irregular, roundish pores. Feet slender, about as long as the shell, triangular, with convex back, strongly divergent, fenestrated at the inflated and thickened base. (Compare the special description of the living form and its soft body in my Monograph.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·04; breadth, *a* 0·03, *b* 0·12, *c* 0·2.

*Habitat.*—Mediterranean, Messina, surface.

Genus 589. *Pterocodon*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three solid free lateral wings on the thorax, and numerous solid terminal feet around the mouth of the abdomen.

The genus *Pterocodon* differs from the closely allied *Pterocorys*, its ancestral form, in the development of numerous solid feet around the terminal mouth, similar to the terminal corona of *Calocyclas*.

1. *Pterocodon campana*, Ehrenberg.

*Pterocodon campana*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 10.
*Pterocodon campana*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xix. fig. 1.

Shell slender, campanulate, subconical, with two distinct strictures. Length of the three joints = 1 : 2 : 4, breadth = 2 : 3 : 5. Cephalis hemispherical, with a conical horn of twice the length. Thorax hemispherical, in the upper part with three divergent, conical horns, as long as the cephalis, and curved downwards. Abdomen with four transverse rows of large circular pores, increasing in size towards the mouth; the largest (undermost), five times as broad as the circular thoracic pores. Mouth not constricted, with a corona of twelve to fifteen divergent, conical feet.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·03, *c* 0·06; breadth, *a* 0·02, *b* 0·05, *c* 0·08.

*Habitat.*—Fossil in Barbados.

2. *Pterocodon ornatus*, n. sp. (Pl. 70, fig. 11).

Shell nearly ovate, with two deep strictures. Length of the three joints = 1 : 3 : 5, breadth = 1 : 5 : 7. Cephalis hemispherical, with a large oblique horn reaching half the length of the

[1] *Pterocodon* = Bell with wings; πτερόν, κώδων.

shell; three edges of the horn wing-shaped and dentated. Thorax hemispherical, in the middle zone with three conical wings, which are half as long as the thorax, and curved downwards. Pores hexagonal, roundish, twice as broad in the inflated abdomen as in the thorax. Mouth constricted, with a corona of from fifteen to eighteen conical, divergent, curved feet, similar to the thoracic wings.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·1; breadth, *a* 0·025, *b* 0·1, *c* 0·14.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Pterocodon favosus*, n. sp.

Shell ovate, with two slight strictures. Length of the three joints = 1 : 2 : 2, breadth = 2 : 4 : 4. Cephalis hemispherical, with a conical horn of twice the length. Three wings of the thorax equal to those of the preceding species. Pores regular, circular, hexagonally framed, of equal size in the thorax and abdomen. Mouth constricted, with a corona of nine straight, conical, nearly vertical feet.

*Dimensions.*—Length of the three joints, *a* 0·0025, *b* 0·05, *c* 0·05; breadth, *a* 0·05, *b* 0·09, *c* 0·1.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Genus 590. *Dictyocodon*,[1] Haeckel, 1881, Prodromus, p. 435.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three latticed free lateral wings on the thorax, and numerous latticed terminal feet around the mouth of the abdomen.

The genus *Dictyocodon*, one of the most elegant among the NASSELLARIA, differs from the preceding *Pterocodon* in the fenestration of the three lateral wings of the thorax, and the numerous terminal feet of the abdomen. It may be derived from *Dictyoceras* by development of regular lattice-feet around the terminal mouth.

### Subgenus 1. *Dictyocodella*, Haeckel.

*Definition.*—The three lateral lattice-wings arise from the thorax alone.

1. *Dictyocodon annasethe*, n. sp. (Pl. 71, fig. 11).

Shell with two deep strictures. Length of the three joints = 2 : 5 : 4, breadth = 1 : 5 : 6. Cephalis subspherical, with a very large, three-sided prismatic horn of three times the length, bearing at the base some smaller accessory spines. Thorax nearly conical, with three large, inflated, triangular lattice-wings, the upper edge of which (the cortinar rod) descends obliquely, and is larger

[1] *Dictyocodon* = Net-bell; δίκτυον, κώδων.

than the thorax, ending in a spine. Abdomen inflated, subcylindrical, divided at the wide open mouth by nine deep incisions into nine large triangular feet. Network in the thorax and wings composed of small, regular, hexagonal pores, in the abdomen of three transverse rows of irregular, very large pores, which are surrounded and separated by bands of very small pores; in each foot one large pore and a marginal series of very small pores occur. I dedicate this wonderful species to the memory of my dear wife, Anna Sethe.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·1, *c* 0·08; breadth, *a* 0·03, *b* 0·1, *c* 0·12.

*Habitat.*—Indian Ocean; Cocos Islands (Rabbe), surface.

2. *Dictyocodon carolotæ*, n. sp. (Pl. 71, fig. 14).

Shell with two deep strictures. Length of the three joints = 1 : 3 : 7, breadth = 2 : 5 : 6. Cephalis hemispherical, with an oblique pyramidal horn of twice the length. Thorax subconical, in the upper half with three divergent, triangular wings of half the length, the upper edge of which is nearly horizontal, little curved. Abdomen nearly cylindrical; divided at the wide open mouth by nine deep incisions into nine triangular, vertical feet, about as large as the wings. Network very delicate, with regular, small, circular pores of equal size and very thin bars. I dedicate this elegant species to my dear mother, Charlotte Sethe.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·14; breadth, *a* 0·04, *b* 0·1, c 0·12.

*Habitat.*—Cape of Good Hope (Bleek), surface.

Subgenus 2. *Dictyocodoma*, Haeckel.

*Definition.*—The three lateral wings are prolonged from the thorax to the abdomen.

3. *Dictyocodon palladius*, n. sp. (Pl. 71, figs. 12, 13).

Shell with distinct collar, but evanescent lumbar stricture. Length of the three joints = 1 : 2 : 7, breadth = 1 : 3 : 8. Cephalis very small, with a large pyramidal horn of twice the length, bearing at its base some small, often branched, accessory spines. Thorax three-sided pyramidal, without external boundary prolonged into the large, inflated, gradually dilated abdomen. The internal boundary between the two is marked by a fenestrated, horizontal ring (not indicated in the figure). Three prominent, triangular, fenestrated wings arise from the base of the cephalic horn, and are prolonged nearly through the whole shell almost to the edge of the mouth; in its lower half they form three elevated fenestrated apophyses, the upper edge of which is nearly horizontal. Mouth divided by about twenty incisions into as many triangular, vertical, fenestrated feet. The network of the whole shell is very delicate, like fine gauze, composed of very small, regular, hexagonal pores.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·055, *c* 0·21; breadth, *a* 0·03, *b* 0·09, *c* 0·25.

*Habitat.*—Central Pacific, Station 271, surface.

4. *Dictyocodon prometheus*, n. sp.

Shell tower-shaped, very similar to the preceding species in form and fenestration, but more slender and different in the longer and three-sided prismatic abdomen. Length of the three joints = 1 : 1 : 8, breadth = 1 : 3 : 7. Cephalis with two large divergent horns of three times the length, which are united by interior prolongations with the basal central point, from which arise the upper edges of the three divergent wings; the ends of the latter are directed downwards. Mouth with a corona of about thirty irregular, triangular feet.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·03, *c* 0·25; breadth, *a* 0·03, *b* 0·08, *c* 0·2.

*Habitat.*—Tropical Atlantic, Station 347, surface.

## Genus 591. *Pleuropodium*,[1] Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) without ribs in the thorax, but with three ribs enclosed in the abdomen, which are prolonged into three terminal feet.

The genus *Pleuropodium*, formerly confounded with *Theopodium* and *Pterocanium*, differs from these two closely allied ancestral genera in the localisation of the three lateral ribs, which have disappeared in the thorax and become limited to the abdomen. It is therefore intermediate between the former and the following *Podocyrtis*.

1. *Pleuropodium charybdeum*, Haeckel.

*Pterocanium charybdeum*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 43, Taf. vi. figs. 7–10.

*Podocyrtis charybdea*, J. Müller, 1856, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 492.

Shell campanulate, armed with scattered, bristle-shaped spines, with sharp collar and slight lumbar stricture. Length of the three joints = 1 : 3 : 1, breadth = 1 : 4 : 5. Cephalis cupola-shaped, with a large prismatic, somewhat curved horn, half as long as the shell. Thorax hemispherical, spiny. Abdomen short and wide, three-sided prismatic, with three stout longitudinal ribs, which are prolonged into three slender, prismatic, nearly vertical, slightly curved feet, about as long as the shell. Pores irregular, roundish, of variable size.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·03; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Mediterranean (Messina, Nice, &c.), surface.

2. *Pleuropodium cortina*, n. sp.

Shell campanulate, smooth, with two distinct strictures. Length of the three joints = 1 : 4 : 2, breadth = 1 : 3 : 4. Cephalis subspherical, with a small, pyramidal, straight horn of the same length.

[1] *Pleuropodium* = Shell with ribs and feet; πλεῦρα, πόδιον.

Thorax pear-shaped, with regular, circular, hexagonally-framed pores. Abdomen three-sided pyramidal, with irregular, roundish pores and three prominent, stout, prismatic ribs, which are prolonged into three straight, divergent feet of the same length.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·04; breadth, *a* 0·025, *b* 0·06, *c* 0·08.

*Habitat.*—North Atlantic, Station 354, surface.

Genus 592. *Podocyrtis*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three simple, terminal feet on the mouth of the abdomen, without lateral ribs or wings. Apex with a horn, which usually is simple.

The genus *Podocyrtis*, and the two following closely allied genera, differ from all the preceding Theopilida in the absence of lateral ribs or wings, and the possession of three free terminal feet, which arise directly from the peristome, or from the margin of the abdominal mouth. They may be derived from *Pleuropodium* by reduction and loss of the three piercing lateral ribs, the terminal free prolongations of which only remain. The genus *Podocyrtis* is one of the largest and most common among all Cyrtoidea, being rich mainly in fossil forms. Ehrenberg in his Polycystins of Barbados (1875, *loc. cit.*, p. 80) enumerated not less than thirty-one species. Some of these are yet living, and occur in the Pacific Radiolarian ooze collected by the Challenger. Other new forms are to be added, so that the number of species described in the following pages amounts to forty-five. Many of these are cosmopolitan, or at least common and widely distributed. To facilitate study we may divide this large genus into four subgenera: in two of these the terminal feet are divergent, or nearly parallel; in the two others convergent. In each of these two groups the pores of the thorax and the abdomen are either nearly equal in size and form, or distinctly different, the abdominal pores being often much larger than the thoracic. The small cephalis bears constantly an apical horn, which is usually simple, rarely branched.

Subgenus 1. *Podocyrtarium*, Haeckel.

*Definition.*—Feet divergent (the distance between their ends being greater than that between their bases). Pores of the thorax and abdomen nearly equal in size and similar in form.

[1] *Podocyrtis* = Basket with feet; πούς, κυρτίς.

1. *Podocyrtis tripodiscus*, n. sp. (Pl. 72, fig. 4).

Shell nearly conical, gradually dilated from the apical to the basal part, with two slight strictures. Surface a little rough. Length of the three joints = 1 : 2 : 4, breadth = 2 : 4 : 6. Pores subregular, circular, quincuncially disposed, of nearly equal size in the conical thorax and the subspherical abdomen. Cephalis hemispherical, with smaller pores and a spindle-shaped spiny horn of twice the length. Feet cylindrical, as long as the abdomen, little divergent, their ends curved outwards and thickened into a papillate knob.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·08; breadth, *a* 0·03, *b* 0·07, *c* 0·11.

*Habitat.*—Central Pacific, Station 265 to 272, depth 2425 to 2925 fathoms.

2. *Podocyrtis attenuata*, Ehrenberg.

*Podocyrtis attenuata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvi. fig. 5.

Shell nearly conical, gradually dilated from the apical to the basal part, with two slight strictures. Surface a little rough. Length of the three joints = 2 : 3 : 4, breadth = 2 : 4 : 5. Pores subregular, circular, equal, quincuncial. Cephalis subspherical, with a conical horn of twice the length. Feet cylindrical, as long as the abdomen, little divergent (sometimes as in the specimen figured, nearly parallel).

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·03, *c* 0·04; breadth, *a* 0·02, *b* 0·04, *c* 0·05.

*Habitat.*—Fossil in Barbados.

3. *Podocyrtis thyrsoceras*, n. sp.

Shell slender, conical, smooth, very similar to *Thyrsocyrtis rhizodon*, Ehrenberg (1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 1), with two slight strictures, nearly of the same form and fenestration as in the preceding smaller species. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis subspherical, with a large cylindrical straight horn, which reaches the length of the abdomen, and is papillate in the distal half. Feet cylindrical, divergent, nearly as long as the whole shell, broadened and spinulated at the distal end.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·06; breadth, *a* 0·02, *b* 0·06, *c* 0·08.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

4. *Podocyrtis conica*, n. sp.

Shell conical, without external strictures, but with two internal septal rings. Surface papillate. Length of the three joints = 2 : 3 : 8, breadth = 3 : 6 : 10. Pores equal, subregular, circular, quincuncial. Cephalis hemispherical, with a thick conical horn of the same length. Feet conical, about as long as the thorax, divergent in the direction of the outline of the conical shell.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·08; breadth, *a* 00·3, *b* 0·06, *c* 0·1.

*Habitat.*—Cosmopolitan, Central Pacific, Stations 263 to 274; Tropical Atlantic, Station 348, in depths between 2350 and 2925 fathoms; also fossil in Barbados.

5. *Podocyrtis corythæola*, n. sp. (Pl. 72, fig. 2).

Shell ovate conical, with two deep strictures, and with rough surface. Length of the three joints = 2 : 5 : 8, breadth = 3 : 8 : 10. Cephalis hemispherical, thorny, with a strong oblique horn three times the length, which is armed with nine to twelve conical spines. Pores small, circular, of irregular size and distribution. Feet spindle-shaped, divergent, as long as the inflated abdomen.

*Dimensions.*—Length of the three feet, *a* 0·02, *b* 0·05, *c* 0·08; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Indian Ocean, Maldive Islands (Haeckel), surface.

6. *Podocyrtis sirena*, n. sp. (Pl. 72, fig. 10).

Shell thin-walled, tower-shaped, smooth, with two deep strictures. Length of the three joints = 2 : 5 : 10, breadth = 3 : 10 : 11. Cephalis subspherical, with a bent conical horn, as long as the hemispherical thorax. Abdomen cylindrical. Pores subregular, circular, quincuncially disposed, and slightly larger in the abdomen. Feet with a thickened calf, nearly perpendicular, as long as the thorax; their distal ends little divergent, and forming a knob beset with small roundish tubercles.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·1; breadth, *a* 0·035, *b* 0·1, *c* 0·11.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

7. *Podocyrtis conulus*, n. sp.

Shell elongate, conical, rough, without external strictures, but with two internal septal rings. Length of the three joints = 3 : 4 : 15, breadth = 5 : 7 : 12. Cephalis hemispherical, with a thick pyramidal horn of the same length. Feet also pyramidal, divergent, of the same size as the horn. Pores irregular, roundish, of variable size. Abdomen very long.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·04, *c* 0·15; breadth, *a* 0·05, *b* 0·07, *c* 0·12.

*Habitat.*—Tropical Atlantic, Station 342, depth 1445 fathoms; also fossil in Barbados.

8. *Podocyrtis tridactyla*, n. sp.

Shell conical, with two slight strictures, smooth. Length of the three joints = 2 : 6 : 5, breadth = 4 : 5 : 6. Cephalis hemispherical, with a pyramidal horn of twice the length. Pores irregular, polygonal, of variable size. Feet as long as the abdomen, constricted in the middle, trilobed at the distal end; the middle lobe twice as large as the lateral lobes.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·05; breadth, *a* 0·04, *b* 0·05, *c* 0·06.

*Habitat.*—Indian Ocean, Madagascar, Rabbe.

## Subgenus 2. *Podocyrtecium*, Haeckel.

*Definition.*—Feet divergent (the distance between their ends being greater than that between their bases). Pores of the thorax and abdomen of different form or size.

9. *Podocyrtis prismatica*, n. sp. (Pl. 72, fig. 1).

Shell conical, rough, with two distinct strictures. Length of the three joints = 1 : 1 : 3, breadth = 1 : 2 : 5. Cephalis subspherical, with a curved conical horn of twice the length. Thorax and abdomen together nearly hemispherical. Pores small, regular, circular, quincuncial, twice as large in the abdomen as in the thorax. Feet very large, twice as long as the whole shell, divergent, bent outwards, prismatic, with strong prominent edges.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·02, *c* 0·06; breadth, *a* 0·02, *b* 0·04, *c* 0·1.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

10. *Podocyrtis brevipes*, Ehrenberg.

*Podocyrtis brevipes*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvi. fig. 6.

Shell conical, smooth, with two slight strictures. Length of the three joints = 2 : 3 : 6, breadth = 2 : 5 : 9. Cephalis subspherical, with a conical horn of the same length. Pores regular, circular, quincuncial, three times as broad in the abdomen as in the thorax. Feet short, triangular, divergent, as long as the horn. (The specimen figured by Ehrenberg was incomplete, one foot and the horn being broken off.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·06; breadth, *a* 0·02, *b* 0·05, *c* 0·09.

*Habitat.*—Fossil in Barbados.

11. *Podocyrtis divergens*, n. sp. (Pl. 72, fig. 6).

Shell slender, subconical, thick-walled, with two distinct strictures. Length of the three joints = 2 : 5 : 7, breadth = 4 : 8 : 10. Cephalis hemispherical, with a large, oblique, prismatic horn three times the length, and a small divergent by-horn at its base. Thorax hemispherical, rough, with regular, circular, quincuncial pores. Abdomen cylindrical, thorny, with larger circular pores of subregular disposition, two to three times as broad as those of the thorax. Feet conical, horn-like, bent, as long as the abdomen; strongly divergent in the distal half.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·07; breadth, *a* 0·04, *b* 0·08, *c* 0·1.

*Habitat.*—Western Tropical Pacific, Station 220, depth 1100 fathoms.

12. *Podocyrtis collaris*, Ehrenberg.

*Podocyrtis collaris*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xvi. fig. 1.

Shell conical, with slight collar and deeper lumbar stricture. Length of the three joints = 1 : 4 : 4, breadth = 1 : 4 : 8. Cephalis hemispherical, with a small oblique horn of the same length. Pores regular, circular, quincuncial, four to six times as broad in the inflated abdomen as in the conical thorax. Feet short and slightly divergent, little longer than the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·08; breadth, *a* 0·03, *b* 0·08, *c* 0·16.

*Habitat.*—Fossil in Barbados.

13. *Podocyrtis ventricosa*, Ehrenberg.

*Podocyrtis ventricosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xvi. fig. 3.

Shell conical, with two deep strictures, thorny. Length of the three joints = 1 : 2 : 5, breadth = 1 : 4 : 8. Cephalis subspherical, with a small conical horn of the same length. Pores regular circular, quincuncial, four to six times as broad in the inflated abdomen as in the hemispherical thorax. (Pores much larger and less numerous than in the similar preceding species.) Feet broad and stout, triangular, divergent, as long as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·1; breadth, *a* 0·025, *b* 0·07, *c* 0·16.

*Habitat.*—Fossil in Barbados.

14. *Podocyrtis flosculata*, n. sp. (Pl. 72, fig. 9).

Shell conical, rough, as broad as long, with distinct collar, but obliterated lumbar stricture. Length of the three joints = 1 : 2 : 4, breadth = 2 : 4 : 7. Cephalis hemispherical, with a thick conical horn of the same length. Thorax truncate, conical, with small, circular, quincuncial pores. Abdomen inflated, with very large and remarkable regular, quincuncial pores; their inner edge circular, the outer six-lobed, the six lobes elegantly alternating with six short conical spines. Feet very coarse, equilateral triangular, half as broad as the thorax, little divergent.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·04, *b* 0·08, *c* 0·14.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

15. *Podocyrtis centriscus*, Ehrenberg,

*Podocyrtis centriscus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xiv. fig. 2.

Shell conical, rough, about as high as broad, with two obliterated strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 4 : 7. Cephalis small, hemispherical, with a stout conical horn. Pores of the inflated abdomen irregular, roundish, very large, three occurring in the course of its length, five times as broad as the small, very numerous, regular, circular pores of the conical thorax. Feet S-shaped, as long as the abdomen, with the blunt end curved outwards.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·02, *b* 0·08, *c* 0·14.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms; fossil in Barbados.

16. *Podocyrtis magnifica*, n. sp. (Pl. 72, fig. 5).

Shell conical, spiny, a little longer than broad, with two distinct strictures. Length of the three joints = 1 : 2 : 5, breadth = 2 : 4 : 7. Cephalis hemispherical, with a large conical horn, which is as long as the abdomen, nearly scaly, and covered with short, simple, and bifid spines. Pores regular, circular, quincuncially disposed, four times as broad in the inflated abdomen as in the

conical thorax. Spines of the former twice as large as those of the latter. Feet very long and slender, cylindrical, S-shaped, bent outwards at the thickened distal end, with a spindle-shaped papillate knob.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·04, *c* 0·1; breadth, *a* 0·04, *b* 0·08, *c* 0·14.

*Habitat.*—Canary Islands, Lanzerote, Haeckel, surface.

### 17. *Podocyrtis princeps*, Ehrenberg.

*Podocyrtis princeps*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xiii. fig. 1.

*Podocyrtis princeps*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 540, Taf. xxxiii. fig. 32.

Shell conical, with two distinct strictures. Length of three joints = 1 : 2 : 5, breadth = 1 : 4 : 7. Cephalis subspherical, with a large cylindrical, vertical horn, longer than the whole shell. Pores regular, circular, quincuncial, in the inflated spiny abdomen very large (four to five in the course of its length), five times as broad as in the smooth conical thorax. Feet about as long as the shell, slightly bent, S-shaped, cylindrical.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·1; breadth, *a* 0·03, *b* 0·08, *c* 0·14.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms; fossil in Barbados.

### 18. *Podocyrtis euceros*, Ehrenberg.

*Podocyrtis euceros*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xv. fig. 1.

Shell conical, campanulate, with two deep strictures. Length of the three joints = 1 : 3 : 6, breadth = 2 : 5 : 7. Cephalis hemispherical, with a large, cylindrical horn, nearly as long as the shell. Pores regular, circular, hexagonally framed, quincuncial, four times as broad in the papillated, inflated abdomen as in the hemispherical, smooth thorax. Feet short and broad, triangular, divergent, about as long as the thorax. (In the specimen figured by Ehrenberg, two feet were broken off).

*Dimensions.*—Length of the three joints, *a* 0·016, *b* 0·05, *c* 0·1; breadth, *a* 0·03, *b* 0·08, *c* 0·12.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, and Pacific Oceans, at many stations, and in various depths; fossil in Barbados.

### 19. *Podocyrtis cristata*, n. sp. (Pl. 72, fig. 7).

Shell conical-campanulate, thorny, with two deep strictures. Length of the three joints = 1 : 2 : 5, breadth = 2 : 4 : 7. Cephalis subspherical, with a large, oblique, little bent, conical horn, as long as the abdomen. Thorax hemispherical, papillaté, with small, regular, circular pores. Abdomen inflated, with very large, circular pores, (three to four in its length), six times as broad as those of the thorax, and separated by hexagonal, serrated crests. Feet cylindrical, stout, S-shaped, slightly divergent, with a spherical papillate knob at the distal end.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·1; breadth, *a* 0·035, *b* 0·07, *c* 0·14.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 20. *Podocyrtis schomburgkii*, Ehrenberg.

*Podocyrtis schomburgkii*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 22; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 82, Taf. xiv. fig. 7.

Shell ovate-conical, with two distinct strictures. Length of the three joints = 2 : 5 : 10, breadth = 3 : 8 : 12. Cephalis hemispherical, with a large, straight, conical horn as long as the abdomen. Thorax campanulate, smooth, with small, regular, circular pores. Abdomen inflated, papillate, with very large, regular, hexagonal pores (three to four in the course of its length), five times as broad as their bars and as the pores of the thorax. Feet as long as the abdomen, nearly parallel, slightly bent outwards at the conical distal end.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·1; breadth, *a* 0·03, *b* 0·08, *c* 0·12.

*Habitat.*—Fossil in Barbados.

### 21. *Podocyrtis hexagonalis*, n. sp.

Shell nearly ovate, slender, everywhere covered with a regular network of high, hexagonal, denticulated crests, separating the circular, funnel-shaped pores, which are twice as large in the subspherical abdomen as in the hemispherical thorax, between both of which are two deep strictures. Length of the three joints = 1 : 3 : 6, breadth = 2 : 5 : 6. Cephalis hemispherical, with a long and thin cylindrical, vertical horn, as long as the abdomen. Feet of the same length and form, nearly straight, slightly divergent.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·12; breadth, *a* 0·04, *b* 0·011, *c* 0·13.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 22. *Podocyrtis ovata*, n. sp.

Shell nearly ovate, papillate, without external strictures. Length of the three joints = 1 : 2 : 3, breadth = 2 : 4 : 5. Cephalis hemispherical, with a pyramidal horn half as long as the shell. Pores regular, circular, hexagonally framed, three times as broad in the inflated abdomen as in the conical thorax. Feet pyramidal, little bent, divergent, about as long as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·08; breadth, *a* 0·05, *b* 0·095, *c* 0·12.

*Habitat.*—Mediterranean, Corfu, Haeckel, surface.

### 23. *Podocyrtis urceolata*, n. sp.

? *Podocyrtis mitra*, Bury, 1862, Polycystins of Barbados, pl. v. fig. 3.

Shell nearly ovate, smooth, with two deep strictures. Length of the three joints = 1 : 2 : 6, breadth = 2 : 4 : 5. Cephalis subspherical, with a stout, conical horn of the same length. Thorax flat, hemispherical, with four to six transverse rows of small circular pores. Abdomen urceolate,

with four to five transverse rows of very large, subregular, hexagonal pores. Feet short and thick, bent outwards, as long as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·15; breadth, *a* 0·05, *b* 0·1, *c* 0·13.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; fossil in Barbados.

### 24. *Podocyrtis ehrenbergii*, Haeckel.

*Podocyrtis amphiacantha*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvii. fig. 3.

Shell slender, ovate, smooth, with deep collar, but evanescent lumbar stricture. Length of the three joints = 1 : 3 : 2, breadth = 1 : 3 : 3. Cephalis subspherical, with a large conical horn, as long as the campanulate thorax. Abdomen nearly cylindrical. Pores irregular, roundish, two to four times as large in the abdomen as in the thorax. Feet conical, slender, divergent, nearly as long as the shell. (In the imperfect specimen figured by Ehrenberg, two spines were broken off.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·04; breadth, *a* 0·02, *b* 0·06, *c* 0·06.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms; fossil in Barbados.

### 25. *Podocyrtis argulus*, Ehrenberg.

*Podocyrtis argulus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvi. fig. 2.

Shell slender, ovate, or subconical, with two deep strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 4. Cephalis hemispherical, with a small conical horn of the same length (broken off in the figure of Ehrenberg). Pores regular, circular, three times as broad in the inflated abdomen as in the campanulate thorax. Feet spindle-shaped, slender, divergent, about as long as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·1; breadth, *a* 0·03, *b* 0·07, *c* 0·1.

*Habitat.*—Tropical Atlantic, Station 247, depth 2530 fathoms; also fossil in Barbados.

## Subgenus 3. *Podocyrtidium*, Haeckel.

*Definition.*—Feet convergent (the distance between their ends being smaller than that between their bases). Pores of the thorax and abdomen nearly equal in size and similar in form.

### 26. *Podocyrtis papalis*, Ehrenberg.

*Podocyrtis papalis*, Ehrenberg, Mikrogeol., Taf. xxxvi. fig. 23; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 82, Taf. xv. fig. 6.

Shell ovate, smooth, without external stricture. Length of the three joints = 1 : 3 : 1, breadth = 1 : 3 : 3. Cephalis ovate, with a stout pyramidal horn of twice the length. Thorax and

abdomen with about thirty longitudinal, divergent ribs, separating the same number of longitudinal rows of regular, circular pores, the size of which increases gradually towards the base. Feet shovel-shaped (broad, triangular, with convex outer and concave inner side, the obtuse end being curved inwards), about as long as the short abdomen, only slightly convergent.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·12, *c* 0·04; breadth, *a* 0·04, *b* 0·12, *c* 0·11.

*Habitat.*—Fossil in Barbados.

### 27. *Podocyrtis costata*, n. sp.

Shell ovate, smooth, of the same form and structure as *Podocyrtis papalis*, but with two distinct strictures and different proportions. Length of the three joints = 1 : 3 : 6, breadth = 2 : 4 : 6. About thirty longitudinal ribs regularly alternating with rows of circular, regular pores. Feet as in *Podocyrtis papalis*.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·12; breadth, *a* 0·04, *b* 0·08, *c* 0·12.

*Habitat.*—Central Pacific, Stations 266 to 272, depth 2425 to 2925 fathoms.

### 28. *Podocyrtis mitrella*, Ehrenberg.

*Podocyrtis mitrella*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xv. fig. 3.

Shell ovate, smooth, nearly of the same form and structure as *Podocyrtis papalis*, but different in the proportions of the joints, in the much smaller, regular pores, and in the great breadth of the shovel-shaped, blunt, about semicircular feet. Length of the three joints = 2 : 9 : 4, breadth = 3 : 10 : 3. Cephalis subspherical, with a thick pyramidal horn of the same length. Slight collar, but no lumbar stricture.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·09, *c* 0·04; breadth, *a* 0·03, *b* 0·1, *c* 0·03.

*Habitat.*—Fossil in Barbados.

### 29. *Podocyrtis mitra*, Ehrenberg.

*Podocyrtis mitra*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 20; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 82, Taf. xv. fig. 4.

Shell ovate, conical, smooth, with two slight strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis with the horn (of equal length) conical. Pores regular, circular, in about twenty longitudinal rows, slightly increasing in size in the middle part of the abdomen. Feet shovel-shaped, blunt, slightly divergent, only as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·5, *c* 0·7; breadth, *a* 0·03, *b* 0·075, *c* 0·1.

*Habitat.*—Cosmopolitan; Mediterranean (Gibraltar), Canary Islands, Central Pacific, Stations 265 to 274, in different depths; also fossil in Barbados.

### 30. *Podocyrtis argus*, Ehrenberg.

*Podocyrtis argus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xvi. fig. 9.

Shell ovate, with two distinct strictures, smooth. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 5. Cephalis subconical, with a conical horn of the same length. Thorax campanulate. Abdomen inflated. Pores subregular, roundish, of nearly equal breadth, quincuncial. Feet shovel-shaped, triangular, nearly vertical, only as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·08; breadth, *a* 0·025, *b* 0·08, *c* 0·1.

*Habitat.*—Tropical Atlantic, Station 347, surface; fossil in Barbados.

### 31. *Podocyrtis eulophos*, Ehrenberg.

*Podocyrtis eulophos*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xiv. fig. 6.

Shell subconical, slender, with two slight strictures, smooth. Length of the three joints = 1 : 2 : 6, breadth = 2 : 4 : 6. Cephalis hemispherical, with a large, spindle-shaped, angular horn of twice the length. Thorax hemispherical. Abdomen truncate, conical. Pores subregular, roundish, in about twenty longitudinal rows, their breadth gradually increasing towards the base. Feet shovel-shaped, blunt, nearly vertical, only as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·16; breadth, *a* 0·05, *b* 0·08, *c* 0·14.

*Habitat.*—Fossil in Barbados.

### 32. *Podocyrtis favosa*, n. sp.

Shell ovate, with two slight strictures, and with honeycomb-like surface. Length of the three joints = 1 : 5 : 2, breadth = 2 : 6 : 5. Cephalis hemispherical, with a pyramidal horn of twice the length. Thorax hemispherical. Pores regular, circular, hexagonally framed, funnel-shaped, with high, prominent crests between them. Feet shovel-shaped, little convergent, triangular, as long as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·04; breadth, *a* 0·04, *b* 0·12, *c* 0·11.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

### 33. *Podocyrtis fusiformis*, n. sp.

Shell slender, nearly spindle-shaped, diminishing gradually from the broadest middle part (immediately above the lumbar septum) towards the two poles. Length of the three joints = 1 : 5 : 8, breadth = 2 : 6 : 5. Cephalis subspherical, with a large conical horn three times the length. Thorax and abdomen with twenty-four to thirty denticulated, longitudinal ribs, separating the same number of longitudinal rows of regular, circular pores. Instead of the lumbar stricture, a broad, internal septum occurs. Feet slender, straight, as long as the abdomen, only slightly convergent.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·1, *c* 0·16; breadth, *a* 0·05, *b* 0·12, *c* 0·1.

*Habitat.*—Indian Ocean, Madagascar (Rabbe) surface.

## Subgenus 4. *Podocyrtonium*, Haeckel.

*Definition.*—Feet convergent (the distance between their ends being smaller than that between their bases). Pores of the thorax and abdomen different in size or form.

### 34. *Podocyrtis pedicellaria*, n. sp. (Pl. 72, fig. 8).

Shell conical, ovate, with two very slight strictures. Length of the three joints = 2 : 3 : 8, breadth = 2 : 4 : 8. Cephalis conical, with a pyramidal horn of the same length. Pores subregular, circular, quincuncially disposed, two to three times as broad in the smooth abdomen as in the rough, spinulate thorax. Feet as long as the thorax, shovel-shaped (broad, triangular, with convex outer and concave inner side, the free ends being curved inwards), only slightly convergent.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·05, *c* 0·16; breadth, *a* 0·05, *b* 0·09, *c* 0·16.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

### 35. *Podocyrtis sinuosa*, Ehrenberg.

*Podocyrtis sinuosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xv. fig. 5.
*Podocyrtis sinuosa*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 540, Taf. xxxiii. fig. 33.

Shell slender, conical, with slight collar, but without lumbar stricture. Length of the three joints = 1 : 2 : 4; breadth = 1 : 2 : 4. Cephalis subspherical (in the figure of Ehrenberg broken off), with a pyramidal horn of the same length. Pores subregular, circular, four times as broad in the abdomen as in the thorax. Feet shovel-shaped, as long as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·12; breadth, *a* 0·03, *b* 0·06, *c* 0·12.

*Habitat.*—Fossil in Barbados.

### 36. *Podocyrtis floribunda*, n. sp.

Shell ovate, conical, with two very slight strictures. Length of the three joints = 2 : 3 : 6, breadth = 2 : 4 : 7. Between twenty-four to thirty longitudinal, denticulated ribs lie the same number of subregular pores, which are flower-like, lobed, or rosette-shaped, and two to three times as large in the abdomen as in the thorax. Feet shovel-shaped (as in the similar *Podocyrtis pedicellaria* (Pl. 72, fig. 8).

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·12; breadth, *a* 0·04, *b* 0·08, *c* 0·14.

*Habitat.*—Tropical Atlantic, Station 342, depth 1445 fathoms; also fossil in Barbados.

### 37. *Podocyrtis scaphopodia*, n. sp.

Shell conical, rough, with two slight strictures. Length of the three joints = 2 : 3 : 5, breadth = 2 : 4 : 8. Cephalis subspherical, with a pyramidal horn of twice the length. Pores subregular,

circular, quincuncial, four times as large in the abdomen as in the thorax. Feet short and broad, triangular, shovel-shaped, with convergent ends. This species is similar to *Podocyrtis brevipes*, but differs in the form and size of the horn and of the feet.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·05; breadth, *a* 0·02, *b* 0·04, *c* 0·08.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

### 38. *Podocyrtis lithoconus*, n. sp. (Pl. 72, fig. 3).

Shell conical, thick-walled, smooth, with two slight strictures. Length of the three joints = 2 : 3 : 6, breadth = 2 : 4 : 7. Cephalis hemispherical, with a spindle-shaped horn of the same length. Pores subregular, circular, two to four times as broad in the abdomen as in the thorax. Feet triangular, shovel-shaped, nearly vertical, as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·12; breadth, *a* 0·04, *b* 0·08, *c* 0·14.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

### 39. *Podocyrtis ampla*, Ehrenberg.

*Podocyrtis ampla*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvi. fig. 7.

Shell conical, thick-walled, with distinct collar, but without lumbar stricture. Length of the three joints = 1 : 4 : 5, breadth = 1 : 6 : 7. Cephalis hemispherical, with a large conical horn, as long as the thorax. Pores regular, circular, quincuncial, three times as broad in the rough abdomen as in the smooth thorax. Feet very small, shovel-shaped, only as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·1; breadth, *a* 0·03, *b* 0·12, *c* 0·14.

*Habitat.*—North Atlantic (Florida); also fossil in Barbados.

### 40. *Podocyrtis nana*, Ehrenberg.

*Podocyrtis nana*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xvii. fig. 2.

Shell conical, thorny, with two distinct strictures. Length of the three joints = 1 : 3 : 3, breadth = 2 : 5 : 6. Cephalis hemispherical, with a large cylindrical horn, nearly as long as the shell. Pores in the abdomen irregular, roundish, two to four times as broad as the regular, circular, quincuncial pores of the thorax. Feet very small, shovel-shaped, scarcely as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·01, *b* 0·03, *c* 0·03; breadth, *a* 0·02, *b* 0·05, *c* 0·06.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms; also fossil in Barbados.

### 41. *Podocyrtis lyœa*, Haeckel.

*Thyrsocyrtis lyœa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 3.

Shell ovate, conical, with two deep strictures. Length of the three joints = 2 : 5 : 8, breadth = 3 : 8 : 9. Cephalis hemispherical, with a large conical horn, which is spinulate, scaly, and as

long as the abdomen. Pores subregular, circular, two to four times as broad in the smooth abdomen as in the spiny thorax. Feet very short and broad, shovel-shaped, scarcely as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·08; breadth, *a* 0·03, *b* 0·08, *c* 0·09.

*Habitat.*—Fossil in Barbados.

### 42. *Podocyrtis bromia*, Haeckel.

*Thyrsocyrtis bromia*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 2.

Shell ovate, thorny, with two distinct strictures. Length of the three joints = 2 : 5 : 5, breadth = 3 : 8 : 9. Cephalis subspherical, with a large conical horn, which is half as long as the shell, and spirally dentated in the distal half. Thorax conical, spinulate, with regular, circular, quincuncial pores. Abdomen tuberculate, with a small number of very large irregular pores. Feet short, shovel-shaped, nearly vertical, as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·05; breadth, *a* 0·03, *b* 0·08, *c* 0·09.

*Habitat.*—Fossil in Barbados.

### 43. *Podocyrtis sphærogaster*, n. sp.

Shell inversely ovate, with two deep strictures. Length of the three joints = 1 : 2 : 6, breadth = 2 : 4 : 7. Cephalis hemispherical, with a slender, slightly bent horn, as long as the abdomen. Thorax hemispherical, spinulate. Abdomen nearly spherical, with much constricted mouth. Pores subregular, circular, hexagonally framed. Feet slender, cylindro-conical, about as long as the shell, with outer convexity, distinctly convergent.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·12; breadth, *a* 0·04, *b* 0·08, *c* 0·14.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### 44. *Podocyrtis tripus*, Haeckel.

*Podocyrtis bicornis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvi. fig. 8.

? *Podocyrtis dipus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xii. fig. 11.

Shell conical, rough, with two deep strictures. Length of the three joints = 1 : 2 : 4; breadth = 1 : 3 : 5. Cephalis subspherical, with a large, oblique, conical horn (sometimes with a small accessory horn at its base), Thorax hemispherical, with subregular, circular, small, quincuncial pores. Abdomen campanulate, with a small number (about twenty) of very large, irregular, polygonal pores. Feet conical, small, as long as the thorax, slightly convergent or nearly vertical.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·03, *b* 0·06, *c* 0·1.

*Habitat.*—Fossil in Barbados.

### 45. *Podocyrtis triacantha*, Ehrenberg.

*Podocyrtis triacantha*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, Taf. xiii. fig. 4.

Shell conical, rough, with two distinct strictures. Length of the three joints = 1 : 2 : 4; breadth = 2 : 4 : 6. Cephalis hemispherical, with a very large conical horn, nearly as long as the whole shell. Thorax campanulate, densely spinulate, with very small, regular, circular, quincuncial pores. Thorax inflated, with very large, irregular, roundish, pores (three to four in the course of its length), five to ten times as broad as those of the thorax. Feet slender and thin, subcylindrical, as long as the abdomen, divergent in the proximal half, convergent and curved inwards in the distal half.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·04, *b* 0·08, *c* 0·12.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

## Genus 593. *Thyrsocyrtis*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three branched terminal feet on the mouth of the abdomen, without lateral ribs or wings. Apex with a horn, which usually bears lateral spines.

The genus *Thyrsocyrtis* differs from the preceding *Podocyrtis*, its ancestral form, in the ramification of the three terminal feet, which in the latter genus remain simple.

### 1. *Thyrsocyrtis rhizodon*, Ehrenberg.

*Thyrsocyrtis rhizodon*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, Taf. xii. fig. 1.

Shell slender, conical, smooth, with two distinct strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis hemispherical, with a large cylindrical horn, reaching half the length of the shell, and papillate in the distal half. Pores nearly equal, regular, circular, quincuncially disposed, small. Feet divergent, about half as long as the shell, broadened and forked at the distal end. (The fork incision is often much deeper, as in the figure given by Ehrenberg.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·06; breadth, *a* 0·03, *b* 0·06, *c* 0·08.

*Habitat.*—Fossil in Barbados.

### 2. *Thyrsocyrtis arborescens*, n. sp. (Pl. 68, fig. 9).

Shell nearly ovate, thorny, with a deep collar, but without lumbar stricture. Length of the three joints = 1 : 2 : 4, breadth = 2 : 3 : 4. Cephalis hemispherical, with a stout scaly or branched horn, half as long as the shell. Pores irregular, roundish, small, separated by spinulated crests, of slightly different sizes. Feet divergent, cylindrical, and as long as the thorax in the proximal half,

[1] *Thyrsocyrtis* = Basket with a thyrsus or apical rod; θύρσος, κυρτίς.

irregularly branched or arborescent in the distal half, with ten to thirty blunt, thickened or papillate, terminal branches.

*Dimensions.*—Length of three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·04, *b* 0·06, *c* 0·08.

*Habitat.*—Central Pacific, Station 268, depth, 2900 fathoms.

### 3. *Thyrsocyrtis furcata*, n. sp.

Shell ovate, thorny, with two slight strictures. Length of the three joints = 1 : 1 : 3, breadth = 1 : 2 : 3. Cephalis hemispherical, with a pyramidal smooth horn of twice the length. Pores of the thorax and abdomen nearly equal, regular, circular, quincuncial. Feet very broad, forked, about as long as the abdomen, much divergent; the outer fork-branch as long as the simple basal half of the foot, and twice as long as the inner or axial branch.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·03, *c* 0·09; breadth, *a* 0·04, *b* 0·06, *c* 0·09.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

### 4. *Thyrsocyrtis rhizopus*, Haeckel.

*Podocyrtis rhizodon*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xv. fig. 2.

Shell pear-shaped, smooth, with two slight strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 5. Cephalis ovate, with a stout, sword-shaped horn of the same length. Pores regular, circular, twice as broad in the inflated abdomen as in the truncate, conical thorax. Feet cylindrical, parallel, vertical, straight, divided at the distal end into two short fork-branches.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·02, *b* 0·06, *c* 0·1.

*Habitat.*—Fossil in Barbados.

### 5. *Thyrsocyrtis rhizopodium*, n. sp. (Pl. 68, fig. 8).

Shell campanulate-conical, with deep collar, but without lumbar stricture. Length of the three joints = 3 : 4 : 10, breadth = 4 : 10 : 15. Cephalis subspherical, with a small conical horn of the same length. Pores regular, circular, quincuncial, three to four times as large in the inflated abdomen as in the truncate, conical thorax. Feet cylindrical, slightly divergent, about as long as the abdomen, S-shaped, bent outwards, irregularly branched in the distal half, with tuberculate terminal branches.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·04, *c* 0·1; breadth, *a* 0·04, *b* 0·1, *c* 0·15.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### 6. *Thyrsocyrtis radicata*, Haeckel.

*Podocyrtis radicata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xiii. fig. 5.

Shell campanulate-conical, with two distinct strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 4 : 6. Cephalis subspherical, with a small conical horn of half the length. Pores regular,

circular, quincuncial, four to five times as broad in the inflated, rough abdomen as in the campanulate, smooth thorax. Feet cylindrical, nearly as long as the whole shell, S-shaped, bent outwards, dilated and hand-shaped at the distal end, divided by three to five incisions in some irregular finger-like branches.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth *a* 0·03, *b* 0·08, *c* 0·12.

*Habitat.*—Fossil in Barbados.

### 7. *Thyrsocyrtis trifida*, n. sp.

Shell campanulate-conical, thorny, with two slight strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 5. Cephalis subspherical, with a short pyramidal horn of the same length. Pores regular, circular, hexagonally framed, twice as broad in the inflated spiny abdomen as in the rough, campanulate thorax. Feet very large, as long as the shell, cylindrical in the proximal simple half, in the distal half broadened and cleft into three large, irregularly lobed branches, two shorter lateral, and one longer abaxial branch; the latter forms the prolongation of the proximal half. The outer straight edges of the three diverging feet correspond to the edges of a three-sided pyramid.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·09; breadth, *a* 0·03, *b* 0·09, *c* 0·15.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

## Genus 594. *Dictyopodium*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theopilida (vel Tricyrtida triradiata aperta) with three latticed terminal feet on the mouth of the abdomen, without lateral ribs or wings. Apex with a horn.

The genus *Dictyopodium* differs from the two preceding ancestral genera in the fenestration of the three terminal feet, which in *Podocyrtis* are simple, in *Thyrsocyrtis* branched, but not latticed.

### 1. *Dictyopodium eurylophus*, Ehrenberg.

*Dictopodium eurylophus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xix. fig. 4.

Shell campanulate-conical, thorny, with two deep strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis hemispherical, with a stout angular horn of twice the length, which at the apex is broadened and divided into some spines. Pores in the hemispherical thorax and in the truncate, conical abdomen of nearly equal size, small, subregular, circular (in the

[1] *Dictyopodium* = Shell with latticed feet; δίκτυον, πόδιον.

abdomen sometimes more irregular and unequal). Feet as long as the abdomen, arising from it with triangular base, diverging, fenestrated throughout the entire length.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·08; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms; fossil in Barbados.

### 2. *Dictyopodium oxylophus*, Ehrenberg.

*Dictyopodium oxylophus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xix. fig. 5.

Shell subconical, smooth, with two slight strictures. Length of the three joints = 2 : 5 : 7, breadth = 3 : 8 : 10. Cephalis subspherical, with a small, conical, smooth horn of the same length. Pores irregular, polygonal, roundish, slightly larger in the abdomen than in the thorax. Feet as long as the thorax, arising from it with triangular base, diverging, fenestrated throughout the entire length. (The figures of this and the preceding species given by Ehrenberg are incomplete, having been drawn from spoiled specimens. In perfect specimens all the three feet are present and diverge in both species in the direction of the conical outline. The main difference between the two species is connected with the pores, which in *Dictyopodium oxylophus* are larger and more irregular, the two strictures are here not so deep.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·07; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Fossil in Barbados.

### 3. *Dictyopodium scaphopodium*, n. sp. (Pl. 73, fig. 8).

Shell campanulate, conical, with two deep strictures. Length of the three joints = 1 : 2 : 6, breadth = 1 : 4 : 8. Cephalis hemispherical, with a conical, smooth horn of twice the length. Thorax hemispherical, rough, with small, regular, circular pores. Abdomen inflated and papillate, with very large, polygonal or roundish pores (eight to ten times as broad as the thoracic pores) Feet divergent, nearly as long as the shell, S-shaped, bent outwards, solid and cylindrical in the proximal half, shovel-shaped and fenestrated in the distal half.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·12; breadth, *a* 0·025, *b* 0·08, *c* 0·16.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### 4. *Dictyopodium cothurnatum*, Haeckel.

*Podocyrtis cothurnata*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. B. 21; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 82, Taf. xiv. fig. 1.

*Anthocyrtis cothurnata*, Haeckel, 1862, Monogr. d. Radiol., p. 310.

Shell subconical, rough, with two deep strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 5. Cephalis hemispherical, with a very large cylindrical, vertical horn, about as long as the whole shell. Thorax conical, rough, with small, regular, circular pores. Abdomen inflated, with very large, roundish pores (four to five in the course of its length), six to eight times

as large as the thoracic pores. Feet nearly vertical, only slightly divergent, S-shaped, bent, as long as the abdomen, cylindrical; at the distal end shovel-shaped and fenestrated (often much more than in Ehrenberg's figure).

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·1; breadth, *a* 0·03, *b* 0·09, *c* 0·15.

*Habitat.*—Fossil in Barbados.

### 5. *Dictyopodium thyrsolophus*, n. sp. (Pl. 73, fig. 7).

Shell subconical, rough, with two slight strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 6. Cephalis hemispherical, with an elegant horn, which is half as long as the shell, spindle-shaped and scaly on the distal third. Thorax hemispherical, with small, regular, circular pores. Abdomen inflated, papillate, with regular, circular pores, three times as large as the thoracic pores (five to six in the course of its length). Feet slightly divergent, cylindrical, about as long as the shell, shovel-shaped and fenestrated (with a prominent middle rib) at the distal end.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·12; breadth, *a* 0·04, *b* 0·1, *c* 0·18.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Subfamily 2. Theoperida, Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Podocyrtida with the basal mouth of the shell fenestrated (vel Tricyrtida triradiata clausa).

## Genus 595. *Lithornithium*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theoperida (vel Tricyrtida triradiata clausa) with three solid lateral wings on the thorax.

The genus *Lithornithium* has an ovate or spindle-shaped shell, with two distinct strictures, and tapering towards both poles. The abdomen is simple, whilst the cephalis bears an apical horn, and the thorax three free, lateral, solid, divergent wings. It may be derived from *Pterocorys* by development of a terminal lattice-plate closing the mouth.

### 1. *Lithornithium ciconia*, n. sp. (Pl. 67, fig. 3).

Shell nearly spindle-shaped, with two indistinct strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 3. Cephalis ovate, with a large pyramidal spine of twice the length. Thorax three-sided pyramidal with three pyramidal wings of the same length, the broad triangular bases of which occupy the whole length of the thoracic edges. Abdomen inversely ovate (in the

[1] *Lithornithium* = Siliceous bird; λίθος, ὀρνίθιον.

figured specimen broken off, in another specimen, found afterwards, completely closed at the distal end). Pores very small, regular, circular, of equal size.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·02, *b* 0·06, *c* 0·06.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

2. *Lithornithium falco*, n. sp. (Pl. 67, fig. 1).

Shell nearly ovate, with two sharp strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 3. Cephalis hemispherical, with a conical spine of the same length. Thorax subspherical, with three conical wings of half the length, little curved, arising with broad triangular base from the upper half of the thorax. Abdomen inversely conical. Pores irregular, roundish, of different sizes.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·07; breadth, *a* 0·03, *b* 0·08, *c* 0·06.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Lithornithium trochilus*, n. sp. (Pl. 67, fig. 4).

Shell nearly spindle-shaped, with two deep strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 2. Cephalis hemispherical, with a thin curved horn of the same length. Cephalis subovate, with three thin curved wings of half the length, arising with broad base from its upper half. Abdomen ovate. Pores subregular, circular, of slightly different sizes.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·5, *c* 0·06; breadth, *a* 0·02, *b* 0·05, *c* 0·04.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

4. *Lithornithium foveolatum*, Ehrenberg.

*Lithornithium foveolatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iv. fig. 7.

Shell subovate, with two distinct strictures. Length of the three joints = 2 : 4 : 3, breadth = 3 : 5 : 4. Cephalis hemispherical, with a short conical spine of the same length. Thorax subspherical, with three broad triangular wings of half the length arising from its lower half. Abdomen subconical. Pores small, regular, circular, of nearly equal size.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·03; breadth, *a* 0·03, *b* 0·05, *c* 0·04.

*Habitat.*—Fossil in Barbados.

5. *Lithornithium fringilla*, n. sp. (Pl. 67, fig. 2).

Shell ovate, with two slight strictures. Length of the three joints = 4 : 7 : 4, breadth = 3 : 7 : 5. Cephalis ovate, with a pyramidal spine of the same length Thorax subconical, with three stout

conical, curved wings of half the length, arising from its lower third (immediately above the girdle). Abdomen inversely campanulate. Pores subregular, circular, of equal size.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·07, *c* 0·04; breadth, *a* 0·03, *b* 0·07, *c* 0·05.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 6. *Lithornithium hirundo*, Ehrenberg.

*Lithocampe hirundo*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 65.
*Lithornithium hirundo*, Ehrenberg, 1854, Mikrogeol., Taf. xix. fig. 53.

Shell nearly ovate, with two deep strictures. Length of the three joints = 2 : 6 : 4, breadth = 2 : 7 : 5. Cephalis hemispherical, with an oblique, conical horn of twice the length. Thorax hemispherical, with three long, angular, little divergent wings of twice the length, which are S-shaped, curved, and arise from its lower third, immediately above the girdle. Abdomen inversely conical. Pores irregular, roundish, of different sizes. In the figure of Ehrenberg the abdomen is broken off; in a specimen from Caltanisetta, with somewhat shorter and broader wings, I found it complete.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·04; breadth, *a* 0·02, *b* 0·07, *c* 0·05.

*Habitat.*—Fossil in Tertiary rocks of the Mediterranean (Ægina, Greece; Caltanisetta, Sicily).

## Genus 596. *Sethornithium*,[1] Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Theoperida (vel Tricyrtida triradiata clausa) with three latticed lateral wings on the thorax.

The genus *Sethornithium* differs from the preceding *Lithornithium*, its ancestral form, only in the fenestration of the three thoracic wings, and bears therefore to it the same relation that *Dictyoceras* exhibits to *Pterocorys*.

### 1. *Sethornithium dictyopterum*, n. sp.

Shell ovate, with two slight strictures. Length of the three joints = 2 : 4 : 3, breadth = 1 : 5 : 4. Cephalis ovate, with a pyramidal horn of twice the length. From the middle part of the thorax arise three broad, triangular, latticed wings of about the same length, the distal end of each of which is curved downwards. Abdomen inversely conical. Pores regular, circular. (Similar to *Lithornithium fringilla*, Pl. **67**, fig. 2, but with much larger wings, which in the greater part are fenestrated.)

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·08, *c* 0·06; breadth, *a* 0·02, *b* 0·1, *c* 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

[1] *Sethornithium* = Latticed bird; σήθω, ὄρνίθιον.

Genus 597. *Theopera*,[1] Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Theoperida (vel Tricyrtida triradiata clausa) with three lateral wings, beginning from the sides of the thorax and prolonged into the sides of the abdomen.

The genus *Theopera* differs from the two preceding genera in the greater extension of the three lateral wings, which are prolonged from their original base, the thorax, into the inversely conical abdomen. It has therefore an intermediate position between the preceding and the following genera. It differs from the similar *Pterocanium* and *Theopodium* in the closure of the constricted and fenestrated mouth.

1. *Theopera prismatica*, n. sp. (Pl. 67, fig. 7).

*Rhopalocanium prismaticum*, Haeckel, 1879, Atlas, pl. lxvii. fig. 7.

Shell three-sided prismatic, with three broad and long hyaline wings, which are prolonged from the collar stricture almost to the basal end, with three parallel edges. Length of the three joints = 2 : 8 : 10, breadth = 3 : 9 : 8. Cephalis hemispherical, with a conical horn of the same length. Thorax subspherical; abdomen inversely ovate; pores of both small, regular, circular, of equal size.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·1; breadth, *a* 0·03, *b* 0·09, *c* 0·08.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

2. *Theopera pyramis*, Haeckel.

*Rhopalocanium* sp., Bury, 1862, Polycystins of Barbados, pl. xvii. fig. 8.

Shell three-sided pyramidal, with three broad and long hyaline wings, which are prolonged from the collar stricture almost to the basal end, with three diverging edges. Length of the three joints = 3 : 8 : 11, breadth = 4 : 8 : 9. Cephalis subspherical, with a conical horn of the same length. Thorax hemispherical; abdomen inversely campanulate. Pores in the abdomen twice to three times as broad as in the thorax, subregular, circular. Differs from the preceding species mainly in the broader pyramidal form and the divergence of the wings.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·11; breadth, *a* 0·04, *b* 0·08, *c* 0·09.

*Habitat.*—Fossil in Barbados.

3. *Theopera fusiformis* (Pl. 67, fig. 5).

Shell nearly spindle-shaped, rough, with two slight strictures. Length of the three joints = 2 : 3 : 6, breadth = 2 : 5 : 4. Cephalis hemispherical, large, with an oblique conical horn of the same length. Thorax hemispherical; abdomen inversely conical. Pores irregular, roundish, of very

[1] *Theopera* = Divine pouch; θεός, πήρα.

different sizes. Three wings short, broad, diverging, triangular, and striated, embracing at the base the lumbar stricture, the lower third of the thorax and the upper third of the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·06, *c* 0·12; breadth, *a* 0·045, *b* 0·1, *c* 0·08.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

### 4. *Theopera luscinia*, Haeckel.

*Lithornithium luscinia*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 78, Taf. iv. fig. 9.

Shell slenderly ovate, with distinct collar, but indistinct lumbar strictures. Length of the three joints = 1 : 3 : 6, breadth = 1 : 5 : 5. Cephalis hemispherical, with a slender cylindrical horn of three times the length, bearing a spindle-shaped spinulate top (like a fir-cone). Pores subregular, circular, twice as broad in the abdomen as in the thorax. Three wings arising with broad triangular base, embracing the lower third of the thorax and the upper third of the abdomen, prolonged into three slender diverging spines, as long as the shell.

*Dimensions.*—Length of the three joints *a* 0·015, *b* 0·05, *c* 0·1; breadth, *a* 0·02, *b* 0·07, *c* 0·07.

*Habitat.*—Fossil in Barbados.

### 5. *Theopera chytropus*, n. sp. (Pl. 67, fig. 6).

Shell slender, ovate, with distinct collar, but indistinct lumbar stricture. Length of the three joints = 1 : 2 : 5, breadth = 1 : 3 : 3. Cephalis hemispherical, with a conical horn of the same length. Pores in the thorax and abdomen of similar shape, irregular, roundish. Three wings with broad triangular base attached at the upper half of the shell, in the lower half free, diverging, with a spinulate knob at the distal end.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·06, *c* 0·15; breadth, *a* 0·03, *b* 0·09, *c* 0·09.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

### 6. *Theopera cortina*, n. sp. (Pl. 67, fig. 8).

Shell slender, ovate, with distinct collar, but indistinct lumbar stricture. Length of the three joints = 1 : 2 : 6, breadth 1 : 4 : 4. Cephalis subspherical, with an elegant pyramidal horn of three times the length, bearing an ovate, spinulate knob. Pores subregular, circular, two or three times as large in the abdomen as in the thorax. The three wings are slightly elevated small ribs on the thorax, arise with broad, triangular, striated bases in the upper half of the abdomen, and are prolonged into three slender diverging feet, which are as long as the shell, and bear a spinulate, ovate knob at the distal end.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·13; breadth, *a* 0·03, *b* 0·08, *c* 0·08.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

Genus 598. *Rhopalocanium*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theoperida (vel Tricyrtida triradiata clausa) with three lateral wings on the sides of the inversely conical abdomen, which bears no vertical terminal horn on the basal apex.

The genus *Rhopalocanium*, and the closely allied *Rhopalatractus* which follows, differ from the preceding *Theopera*, their probable ancestral form, in the origin of the three lateral wings from the inversely conical abdomen, the thorax bearing no wings. The upper part of the wing bases, which arose formerly from the thorax, is here reduced and lost.

1. *Rhopalocanium lasanum*, n. sp. (Pl. 67, fig. 10).

Shell subovate, with two distinct strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis hemispherical, with a conical, dimpled horn of twice the length. Thorax subconical, abdomen campanulate, both with irregular, circular pores. Three wings cylindrical, divergent, about as long as the shell, striated, with an ovate, dimpled knob at the distal end, their broad triangular base being attached to the upper half of the abdomen. (Form rather variable.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·09; breadth, *a* 0·03, *b* 0·09, *c* 0·12.

*Habitat.*—Central Pacific, Stations 263 to 268, depth 2650 to 3000 fathoms.

2. *Rhopalocanium ornatum*, Ehrenberg.

*Rhopalocanium ornatum*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 9; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 82, Taf. xvii. fig. 8.

Shell nearly spindle-shaped, with two distinct strictures. Length of the three joints = 1 : 3 : 6, breadth = 1 : 4 : 3. Cephalis hemispherical, with a stout, cylindrical horn of twice the length, bearing a dimpled cone. Thorax ovate, campanulate. Abdomen inversely conical. Pores subregular, circular, twice as large in the thorax as in the abdomen. Three wings compressed, slender, divergent, slightly longer than the abdomen, bearing an ovate, dimpled cone at their distal end, with the broad, triangular, striated base attached to the upper third of the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·12; breadth, *a* 0·025, *b* 0·08, *c* 0·07.

*Habitat.*—Fossil in Barbados.

3. *Rhopalocanium cortinium*, n. sp.

Shell slender, ovate, nearly of the same form as, and with similar fenestration to that of *Theopera cortina*, (Pl. 67, fig. 8). It differs from the latter mainly by the absence of the three thoracic ribs, characteristic of *Theopera*. Length of the three joints = 1 : 2 : 6, breadth = 1 : 4 : 4. The

[1] *Rhopalocanium* = Basket with clubs; ῥόπαλον, κάνεον.

three wings arise by a broad, triangular, striated base from the upper half of the abdomen, below the lumbar stricture. The cephalic horn and the three divergent wings are shorter, and at the distal end not so much thickened as in *Theopera cortina*.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·045, *c* 0·12 ; breadth, *a* 0·03, *b* 0·07, *c* 0·08.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

### 4. *Rhopalocanium pythia*, n. sp.

*Rhopalocanium ornatum*, Bury, 1862, Polycystins of Barbados, pl. vi. fig. 1.

Shell nearly ovate, with two deep strictures. Length of the three joints = 1 : 4 : 8, breadth = 1 : 4 : 4. Cephalis subspherical, with a conical horn of three times the length. Thorax inflated, abdomen inversely campanulate and prolonged into a short, conical, latticed tube. Pores subregular, circular. Three wings slender, as long as the abdomen, arising by a broader base from the uppermost part of the abdomen, their thickened end being curved inwards.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·15 ; breadth, *a* 0·03, *b* 0·08, *c* 0·07.

*Habitat.*—Fossil in Barbados.

### 5. *Rhopalocanium delphicum*, n. sp. (Pl. 67, fig. 9).

Shell nearly spindle-shaped, with two deep strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 3. Cephalis hemispherical, with a slender, conical, curved horn, as long as the hemispherical thorax. Abdomen inversely campanulate, prolonged into a short, conical, latticed tube. Pores subregular, circular. Three wings arising by a narrow base from the uppermost part of the abdomen, slender, cylindrical, S-shaped, curved, divergent, with a thick scaly appendix like a fir-cone at the distal end.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·07, *c* 0·14 ; breadth, *a* 0·03, *b* 0·09, *c* 0·08.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Genus 599. *Rhopalatractus*,[1] Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Theoperida (vel Tricyrtida triradiata clausa) with three lateral wings on the sides of the inversely conical abdomen, which bears a vertical terminal horn on the basal apex.

The genus *Rhopalatractus*, one of the most remarkable forms of Tricyrtida, differs from the preceding *Rhopalocanium*, its ancestral form, in the production of a vertical, basal horn, which descends from the basal apex of the inversely conical abdomen, and is opposed to the upper apical horn of the cephalis. The shell becomes here, therefore, exquisitely spindle-shaped.

[1] *Rhopalatractus* = Spindle with clubs ; *ῥόπαλον*, *ἄτρακτος*.

1. *Rhopalatractus pentacanthus*, n. sp. (Pl. 68, fig. 11).

Shell very thick-walled, with two sharp strictures. Length of the three joints = 1 : 6 : 8, breadth = 1 : 6 : 7. Cephalis hemispherical, with conical cavity, and a conical horn of twice the length. Thorax subspherical, separated from the abdomen by a deep lumbar stricture, with small, regular, circular, hexagonally-framed pores. Abdomen three-sided prismatic, with three strong, prominent, wing-shaped edges, which are slightly divergent towards the base, and prolonged into three pyramidal feet about as long as the thorax. Pores of the abdomen disposed in longitudinal rows, which are separated by denticulate crests. Abdominal base inversely pyramidal, and prolonged into a very large, cylindrical, basal, axial spine, nearly as long as the whole shell.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·12, *c* 0·15; breadth, *a* 0·03, *b* 0·11, *c* 0·14.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

2. *Rhopalatractus foveolatus*, n. sp. (Pl. 68, fig. 10).

Shell slenderly ovate, thick-walled, with rough, dimpled surface. Length of the three joints = 1 : 3 : 5, breadth = 2 : 4 : 4. Cephalis hemispherical, with spherical cavity, and a thick, conical spine of the same length. Thorax subspherical, with subregular, circular pores. Abdomen inversely conical, with larger, irregular, roundish pores, prolonged at the distal end into a cylindrical, axial, basal spine of about half its length. From the middle part of the abdomen arise three lateral, conical feet, which are slightly curved and divergent downwardly, scarcely as long as the basal spine. All five spines are dimpled.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·1; breadth *a* 0·04, *b* 0·08, *c* 0·08.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Rhopalatractus fusiformis*, n. sp.

Shell slender, spindle-shaped, nearly of the same form as in the preceding species. Length of the three joints = 1 : 2 : 6, breadth = 1 : 2 : 2. Cephalis subspherical, with a cylindrical horn three times the length. Pores subregular, circular, of equal breadth in the thorax and in the abdomen, which is prolonged into a cylindrical, axial, basal spine of the same length. From the upper third of the abdomen arise, from a broad triangular base, three conical wings of half the length, divergent and slightly curved inwards.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·15; breadth, *a* 0·03, *b* 0·06, *c* 0·06.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

4. *Rhopalatractus fenestratus*, n. sp. (Pl. 68, fig. 12).

*Dictyatractus fenestratus*, Haeckel, 1881, Prodromus et Atlas.

Shell nearly spindle-shaped, with two distinct strictures. Length of the three joints = 1 : 3 : 6, breadth = 1 : 4 : 4. Cephalis hemispherical, with a large, club-shaped horn, nearly as long as the abdomen, sulcated by longitudinal ribs, which are elegantly denticulate in the distal half. Thorax

subspherical. Abdomen subovate, prolonged into a pyramidal, axial, basal spine, half as long as the thorax. Pores subregular, circular. From the upper half of the abdomen arise three stout, lateral, divergent wings of about the same length, which are curved inwards and fenestrated both at the broad triangular base and at the thickened, three-edged distal end.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·12; breadth, *a* 0·03, *b* 0·08, *c* 0·08.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Genus 600. *Lithochytris*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theoperida (vel Tricyrtida triradiata clausa) with a three-sided pyramidal abdomen, the triangular base of which is prolonged at the three corners into three terminal feet.

The genus *Lithochytris* differs from all the other Theoperida in the absence of lateral wings and the possession of three divergent, terminal feet, which arise from the three corners of the three-sided pyramidal abdomen. It repeats, therefore, among the Tricyrtida, that characteristic formation which *Sethochytris* and *Tetrahedrina* represent among the Dicyrtida. Some species may be derived from *Pterocanium*, other species from *Podocyrtis*, by the development of a lattice-plate closing the terminal mouth.

### Subgenus 1. *Lithochytrodes*, Haeckel.

Three feet of the abdomen solid, not fenestrated, representing external apophyses of the triangular shell-base.

#### 1. *Lithochytris cortina*, n. sp. (Pl. 67, fig. 12).

Shell three-sided pyramidal, without external strictures, but with two internal girdles. Length of the three joints = 2 : 2 : 5, breadth = 3 : 4 : 6. Cephalis large, truncate-pyramidal, with nine deep divergent ribs (and nine longitudinal rows of pores between them), and with a stout pyramidal horn of half the length. The three prominent edges of the thorax and abdomen are prolonged over the base of the pyramid into three very stout, solid, subovate feet, about as long as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·04, *c* 0·1; breadth, *a* 0·06, *b* 0·08, *c* 0·12.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

#### 2. *Lithochytris pyriformis*, n. sp. (Pl. 67, fig. 13).

Shell pyramidal, nearly pear-shaped, with two distinct strictures. Length of the three joints = 1 : 1 : 3, breadth = 1 : 2 : 3. Cephalis large, pear-shaped, with a short pyramidal horn of half the

[1] *Lithochytris* = Pot of silex; λίθος, χυτρίς.

length. Thorax and abdomen rounded, without prominent edges. Three basal feet pyramidal, solid, nearly vertical, as long as the thorax. Pores irregular, roundish, in the abdomen large, twice to three times as broad as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·03, *c* 0·08; breadth, *a* 0·04, *b* 0·06, *c* 0·09.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

### 3. *Lithochytris tripodium*, Ehrenberg.

*Lithochytris tripodium*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iv. fig. 11.

Shell pyramidal, nearly pear-shaped, with two distinct strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 2 : 5. Cephalis with a horn of the same length, conical. Thorax and abdomen rounded, without prominent edges. Three basal feet conical, solid, strongly divergent, shorter than the thorax. Pores subregular, circular, twice as broad in the abdomen as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·03, *b* 0·05, *c* 0·1.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Lithochytridium*, Haeckel.

*Definition.*—Three feet of the abdomen hollow and fenestrated, representing direct protuberances or corner prolongations of the triangular shell-base.

### 4. *Lithochytris galeata*, n. sp. (Pl. 67, fig. 16).

Shell pyramidal, with two sharp strictures. Length of the three joints = 1 : 1 : 4, breadth = 1 : 2 : 4. Cephalis subspherical, with an oblique pyramidal horn of the same length. Thorax somewhat larger. Abdomen inflated, with three sharp, prominent edges, which are prolonged over the shell-base into three pyramidal, hollow, and fenestrated feet, longer than the thorax. Pores subregular, circular, twice as broad in the abdomen as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·025, *c* 0·1; breadth, *a* 0·025, *b* 0·05, *c* 0·1.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 5. *Lithochytris pileata*, Ehrenberg.

*Lithochytris pileata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. v. fig. 3.

Shell three-sided pyramidal, with deep collar, but indistinct lumbar stricture. Length of the three joints = 2 : 2 : 9, breadth = 3 : 5 : 10. Cephalis with a conical horn of the same length, pear-shaped. Thorax very short and broad. Abdomen inflated, with three sharp, prominent edges, which

are prolonged over the shell-base into three pyramidal, hollow and fenestrated feet, the lower edge of which is horizontal. Pores regular, circular, of equal size in the thorax and abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·02, *c* 0·09; breadth, *a* 0·03, *b* 0·05, *c* 0·1.

*Habitat.*—Fossil in Barbados.

### 6. *Lithochytris lucerna*, n. sp. (Pl. 67, fig. 14).

Shell three-sided pyramidal, with two indistinct strictures. Length of the three joints = 1 : 2 : 5, breadth = 2 : 3 : 8. Cephalis small, with a horn of the same length, conical. Thorax with subspherical cavity. Abdomen with three rounded, prominent edges, which are prolonged over the shell-base into three conical, hollow, and fenestrated feet, twice as long as the thorax, with a thick, pyramidal, terminal spine. Pores subregular, circular, of equal size in the thorax and abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·1; breadth, *a* 0·04, *b* 0·06, *c* 0·16.

*Habitat.*—South Pacific, Station 297, depth 1775 fathoms.

### 7. *Lithochytris lanterna*, n. sp. (Pl. 67, fig. 11).

Shell three-sided pyramidal, with two distinct strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 6. Cephalis small, with a pyramidal slender horn of twice the length. Thorax with subspherical cavity. Abdomen with three sharp prominent edges, which are prolonged over the convex shell-base into three slender, prismatic, hollow, fenestrated feet, strongly divergent, twice as long as the thorax (seen in fig. 11 from the vaulted base). Pores circular, twice as broad in the abdomen as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·02, *b* 0·06, *c* 0·12.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 8. *Lithochytris pyramidalis*, Ehrenberg.

*Lithochytris pyramidalis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. v. fig. 1.

Shell three-sided pyramidal, without external strictures, but with two internal transverse girdles. Length of the three joints = 1 : 2 : 6, breadth = 2 : 4 : 8. Cephalis with a short horn of half the length, conical. Cavity of the thorax subspherical. Abdomen with three rounded edges, prolonged over the concave base into three pyramidal, hollow, and fenestrated feet, twice as long as the thorax. Pores large, irregular, roundish.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·12; breadth, *a* 0·04, *b* 0·08, *c* 0·16.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms; fossil in Barbados.

### 9. *Lithochytris pteropus*, n. sp. (Pl. 67, fig. 15).

Shell three-sided pyramidal, with two indistinct strictures, but with two broad, internal girdles. Length of the three joints = 2 : 2 : 6, breadth = 2 : 3 : 9. Cephalis with a small horn of half the

length, pear-shaped. Thorax broader than long. Abdomen with three prominent, rounded edges, prolonged over the concave base into three conical, hollow, and fenestrated feet, twice as long as the thorax. Pores small, circular, irregular, in longitudinal series along the edges.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·04, *c* 0·12; breadth, *a* 0·04, *b* 0·06, *c* 0·18.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

10. *Lithochytris vespertilio*, Ehrenberg.

*Lithochytris vespertilio*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 76, Taf. iv. fig. 10.

Shell three-sided pyramidal, with two indistinct strictures. Length of the three joints = 1 : 2 : 5, breadth = 2 : 3 : 10. Cephalis with a short horn of half the length, conical. Thorax inflated. Abdomen without prominent edges, divided in the lower half into three large, conical, hollow, and fenestrated feet, twice as long as the thorax. Pores small, irregular, roundish.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·1; breadth, *a* 0·04, *b* 0·06, *c* 0·2.

*Habitat.*—Fossil in Barbados.

## Family LXVI. Phormocyrtida, n. fam.

*Theophormida et Theophœnida*, Haeckel, 1881, Prodromus, pp. 436, 437.

*Definition.*—Tricyrtida multiradiata. (Cyrtoidea with a three-jointed shell, divided by two transverse constrictions into cephalis, thorax, and abdomen, with numerous, four to nine or more, radial apophyses.)

The family Phormocyrtida, composed of the Theophormida and Theophœnida of my Prodromus, comprises those Cyrtoidea in which the lattice-shell is three-jointed, and bears numerous radial appendages (usually six or nine, sometimes more, rarely less, four or five). The two subfamilies differ in the shape of the terminal mouth, which is in the Theophormida a simple wide opening, in the Theophœnida closed by a lattice-plate. The phylogenetic origin of the Phormocyrtida may be found either in the Podocyrtida or in the Anthocyrtida; they may be derived either from the former by interpolation of interradial, secondary apophyses between the three primary perradial apophyses; or from the latter by development of an abdomen.

The radial apophyses are originally radial ribs, which arise from the base of the cephalis on the collar stricture, run along the thorax and abdomen, and are often prolonged into terminal feet. Whilst in some forms the radial ribs are completely preserved in both joints, they are in other forms only partly visible (in the abdomen), and very often only their free terminal prolongations are preserved in the form of a corona of feet around the mouth of the thorax. This corona is either simple or double. Sometimes also a corona is developed on the lumbar stricture, between the thorax and abdomen.

These apophyses exhibit a remarkable variety in the great subfamily Theophormida, with open mouth. In the small subfamily Theophænida, however, the apophyses appear as six or nine simple lateral wings on the abdomen.

The Theophormida are richly represented not only in the present seas, but also as fossils in Barbados, and numerous remarkable forms have been already described by Ehrenberg, in his genera *Calocyclas* and *Cycladophora*. Many Phormocyrtida belong to the most elegant and admirable forms of Radiolaria.

*Synopsis of the Genera of Phormocyrtida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Theophormida. Terminal mouth of the abdomen a simple wide opening. | Radial ribs enclosed in the wall of the shell, either the thorax or the abdomen. | Radial ribs in the thorax and the abdomen. | Abdomen flat, dilated, with a wide open mouth, . | 601. *Theophormis.* |
| | | | Abdomen ovate or cylindrical, with constricted mouth, . . . | 602. *Phormocyrtis.* |
| | | Radial ribs in the abdomen only. | Peristome with free terminal feet, . . | 603. *Alacorys.* |
| | | | Peristome smooth, without free feet, . . | 604. *Cycladophora.* |
| | No radial ribs in the shell-wall. Peristome with a corona of terminal feet. | Terminal corona simple. | Abdomen cylindrical or ovate, not dilated, . | 605. *Calocyclas.* |
| | | | Abdomen dilated, truncate, conical or discoidal, . | 606. *Clathrocyclas.* |
| | | Corona of feet double. | Both coronas terminal, . | 607. *Lamprocyclas.* |
| | | | One corona terminal, the other lumbar, . . | 608. *Diplocyclas.* |
| II. Subfamily Theophænida. | Terminal mouth of the abdomen closed by a lattice-plate. | | Six lateral wings, . . | 609. *Hexalatractus.* |
| | | | Nine lateral wings, . . | 610. *Theophœna.* |

Subfamily 1. THEOPHORMIDA, Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Phormocyrtida with the basal mouth of the shell open (vel Tricyrtida multiradiata aperta).

Genus 601. *Theophormis*,[1] Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Theophormida (vel Tricyrtida multiradiata aperta) with numerous radial ribs enclosed in the wall of the thorax and of the flat dilated abdomen; mouth of the latter wide open.

[1] *Theophormis* = Divine basket; θεός, φορμις.

The genus *Theophormis* commences the series of the Theophormida, or the multiradiate Podocyrtida, as their oldest and simplest form. The three-jointed shell is flat, campanulate or hat-shaped, and pierced by four or more radial ribs, four of which are primary or perradial, the others secondary or interradial. *Theophormis* may be derived from the similar *Sethophormis* by development of a lumbar constriction, and a third joint or abdomen.

1. *Theophormis callipilium*, n. sp. (Pl. 70, figs. 1–3).

Shell flat, hat-shaped, with two sharp annular strictures. Cephalis large, flatly cap-shaped, with small, irregular, square meshes (fig. 3). The collar septum (fig. 2) is composed (as in the following species) of four crossed, thin, horizontal beams, each of which is inserted at the collar stricture by a three forked branch. From the centre of the collar stricture (in the common nodal point of the four beams) there arises a vertical, axial rod, which is inserted at the flat top of the cephalis by five branches (one central and four lateral). Length of the three joints = 1 : 3 : 2, breadth = 2 : 6 : 11. Thorax flat, campanulate, with four primary perradial ribs (prolongations of the four cortinar beams), and numerous (twenty to thirty) interpolated secondary ribs; four of these are interradial (midway between the four primary ribs), and bisect the four large, semicircular, perradial meshes at the base of the thorax. Network of the thorax and abdomen subregular, with hexagonal meshes and thin bars. Abdomen flatly expanded, somewhat curved, like the brim of a hat, half as broad in the anterior (frontal) part as in the posterior (occipital) part, which is about as broad as the radius of the thorax. The twenty to thirty radial ribs of the abdomen are prolongations of the thoracic ribs, and are somewhat prominent at the margin of the peristome, which appears therefore elegantly indented.

*Dimensions.*—Length of the three joints, *a* 0·02 to 0·03, *b* 0·06 to 0·08, *c* 0·03 to 0·06; breadth, *a* 0·05 to 0·08, *b* 0·2 to 0·3, *c* 0·4 to 0·5.

*Habitat.*—Central Pacific, Station 271, surface.

2. *Theophormis medusa*, n. sp.

Shell flatly campanulate, with two distinct, annular strictures. Length of the three joints = 1 : 2 : 1, breadth = 2 : 5 : 8. Cephalis large, hemispherical. Thorax flatly conical, with four crossed ribs, opposite in pairs in two meridional planes, perpendicular one to another, and prolonged into the flat, nearly discoidal abdomen, which is half as broad as the thorax. The wall of the abdomen is pierced by eight radial ribs; four secondary ribs being interpolated between the four primary. Network of the entire shell very delicate, with regular, hexagonal meshes, and very thin bars. Peristome circular, not dentate.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·07, *c* 0·04; breadth, *a* 0·06, *b* 0·16, *c* 0·24.

*Habitat.*—Central Pacific, Station 266, surface.

3. *Theophormis cruciata*, n. sp.

Shell flat, campanulate, with two distinct annular strictures. Cephalis flat, cap-shaped, with irregular, square meshes. Thorax flat, conical, with hexagonal meshes. Abdomen flatly expanded,

of half the breadth, with larger hexagonal meshes. Thorax and abdomen pierced by four stout radial ribs, lying opposite in pairs in two diameters, perpendicular one to another. No secondary or interradial ribs are interpolated between the four primary. Mouth truncate, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·04; breadth, *a* 0·05, *b* 0·18, *c* 0·25.

*Habitat.*—Central Pacific, Station 274, surface.

### 4. *Theophormis senaria*, n. sp.

Shell flat, hat-shaped, similar to *Theophormis callipilium* (Pl. **70**, figs. 1–3), but with a different number and arrangement of the piercing radial ribs. The cephalis and its collar septum exhibit the same formation as in *Sethophormis hexalactis*, described above (p. 1245, Pl. **56**, fig. 6.) The caudal and sternal ribs, which are opposed in the sagittal plane, are simple, whilst the two lateral ribs are forked. In the flat abdomen there are six secondary or interradial ribs, interpolated between the six primary or perradial ribs of the thorax. Delicate network with regular, hexagonal meshes.

*Dimensions.*—Length of the three joints, *a* 0·035, *b* 0·075, *c* 0·025; breadth, *a* 0·07, 0·2, *c* 0·3.

*Habitat.*—Central Pacific, Station 272, surface.

## Genus 602. *Phormocyrtis*,[1] n. gen.

*Definition.*—Theophormida (vel Tricyrtida multiradiata aperta) with numerous radial ribs enclosed in the wall of the thorax, and of the ovate or cylindrical abdomen; mouth of the latter constricted.

The genus *Phormocyrtis* differs from the preceding *Theophormis* in the ovate or cylindrical form of the abdomen, the mouth of which is more or less constricted. The former exhibits, therefore, the same relation to the latter that *Sethamphora* bears to *Sethophormis* among the Dicyrtida. *Phormocyrtis* may be derived directly either from *Sethamphora* by development of an abdomen, or from *Pterocorys* or *Theopilium* by multiplication of the three radial ribs.

### 1. *Phormocyrtis carinata*, n. sp.

Shell ovate, with two slight strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis hemispherical, with a stout pyramidal horn of twice the length, and few very small pores. Pores in the campanulate thorax and the inflated abdomen regular, circular, small, and numerous. Six stout prominent ribs, beginning from the collar stricture, arise along the thorax and abdomen, and reach the constricted mouth, which is half as broad as the abdomen. (This species is very similar to *Pterocorys carinata*, from which it differs in the six complete radial ribs of the shell-wall.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·09; breadth, *a* 0·03, *b* 0·09, *c* 0·12.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

[1] *Phormocyrtis* = Plaited basket; φορμός, κυρτίς.

2. *Phormocyrtis fastosa*, Haeckel.

*Eucyrtidium fastosum*, Ehrenberg, 1872 Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. ix. fig. 19.

Shell ovate, with two distinct strictures. Length of the three joints = 1 : 3 : 3, breadth = 1 : 5 : 6. Cephalis ovate, with a stout pyramidal horn of the same length, and numerous rather large pores. Pores in the campanulate thorax and the inflated abdomen much smaller, very numerous, regular, hexagonal. Along these two joints arise nine delicate, divergent ribs; these extend almost to the wide mouth, which is slightly constricted.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·08; breadth, *a* 0·02, *b* 0·1, *c* 0·12.

*Habitat.*—Indian Ocean (Zanzibar), depth 2200 fathoms, Pullen.

3. *Phormocyrtis costata*, n. sp. (Pl. 69, fig. 6).

Shell smooth, with sharp collar, but indistinct lumbar stricture. Length of the three joints = 2 : 5 : 5, breadth = 2 : 6 : 6. Cephalis conical, with a stout pyramidal horn of twice the length. Thorax and abdomen together nearly cylindrical, constricted towards both poles, with thirty to forty longitudinal ribs, which are nearly parallel, vertical in the middle part, and convergent towards both poles; alternate with the same number of longitudinal rows of regular, circular pores. Mouth with a broad, hyaline, only slightly constricted peristome.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·1, *c* 0·1; breadth, *a* 0·04, *b* 0·12, *c* 0·12.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

4. *Phormocyrtis embolum*, Haeckel.

*Eucyrtidium embolum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 5.

Shell smooth, with sharp collar, but indistinct lumbar stricture. Length of the three joints = 3 : 7 : 10, breadth = 3 : 9 : 7. Cephalis subspherical, with a pyramidal horn of the same length. Thorax campanulate; abdomen inversely truncate, conical; both with sixteen to twenty longitudinal ribs, and alternate longitudinal rows of small circular pores, converging towards the two poles. Mouth truncate, with broad hyaline peristome.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·07, *c* 0·1; breadth, *a* 0·03, *b* 0·09, *c* 0·07.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms; fossil in Barbados.

5. *Phormocyrtis quadrata*, n. sp.

Shell ovate, papillate, with two slight strictures. Length of the three joints = 2 : 3 : 13, breadth = 4 : 6 : 11. Cephalis hemispherical, small, with two divergent, pyramidal horns of twice the length. Along the hemispherical thorax and the ovate inflated abdomen run twenty-four to thirty curved ribs, converging towards the two poles, and alternate with the same number of longi-

tudinal rows of circular, regular pores, disposed in ten to twelve transverse rows. Each pore with a square, elevated frame. Mouth constricted, only one-third as broad as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·13; breadth, *a* 0·04, *b* 0·06, *c* 0·11.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

### 6. *Phormocyrtis longicornis*, n. sp. (Pl. 69, fig. 15).

*Theocorys longicornis*, Haeckel, 1881, Prodromus et Atlas, *loc. cit.*

Shell slender, ovate, rough, with two slight strictures. Length of the three joints = 3 : 8 : 12, breadth = 4 : 10 : 11. Cephalis hemispherical, with a very large, cylindrical horn, about as long as the shell. Thorax hemispherical, with regular, circular, hexagonally-framed pores. Abdomen subcylindrical, with twenty to twenty-four nearly parallel undulate ribs, and alternate longitudinal rows of regular, circular pores. Mouth constricted, circular, about half as broad as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·12; breadth, *a* 0·04, *b* 0·1, *c* 0·11.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

## Genus 603. *Alacorys*,[1] Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Theophormida (vel Tricyrtida multiradiata aperta) with numerous radial ribs in the abdomen, which are prolonged over the mouth into free feet.

The genus *Alacorys* and the following *Cycladophora* differ from the preceding two genera in the formation of the radial ribs, which arise from the lumbar stricture, and lie in the wall of the abdomen, but are absent on the thorax. The shell is usually large, more or less pyramidal or conical, with a wide open terminal mouth. The latter is in *Cycladophora* simply truncate, whilst in *Alacorys* it is surrounded by from four to twelve or more terminal feet, prolongations of the abdominal ribs. According to the different number of these (four, five, six, or more) some subgenera may be distinguished, as *Tetralacorys*, *Pentalacorys*, *Hexalacorys*, &c.

### Subgenus 1. *Tetralacorys*, Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Peristome armed with four feet, opposite in two meridian planes, which are perpendicular to one another.

### 1. *Alacorys lutheri*, n. sp. (Pl. 65, fig. 4).

Shell papillate, with distinct collar stricture. Length of the three joints = 3 : 6 : 6, breadth = 3 : 8 : 10. Cephalis subpherical, with a pyramidal horn of the same length. Thorax tuberculate,

[1] *Alacorys* = Wing-helmet.

nearly hemispherical, with circular pores of very different sizes. From the margin of its wide open mouth descend four stout perradial ribs, which are forked at the distal end, and by communication of their fork-branches form the four large, pentagonal holes of the abdomen. From the middle of the lower margin of the holes descend four parallel, vertical, slender feet, about as long as the shell. This species is dedicated to the memory of the great Reformer, Martin Luther.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·06; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 2. *Alacorys tetracantha*, Haeckel.

*Podocyrtis tetracantha*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xiii. fig. 2.

? *Podocyrtis parvipes*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xiv. fig. 5.

Shell rough, with distinct collar stricture. Length of the three joints = 1 : 3 : 5, breadth = 1 : 4 : 6. Cephalis subspherical, with a rudimentary conical horn. Thorax campanulate, with irregular, roundish pores of different sizes. Abdomen inflated, with a small number of very large irregular holes, intermingled with smaller roundish holes. From the margin of the wide open mouth descend, nearly vertically, four strong vertical feet, which are about as long as the shell, and slightly curved, with convex outlines. *Podocyrtis parvipes* of Ehrenberg seems to be only a mutilated specimen of this species.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·09; breadth, *a* 0·03, *b* 0·08, *c* 0·13.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Pentalacorys*, Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Peristome armed with five feet, one of which is odd and occipital, the other four paired and lateral.

### 3. *Alacorys pentacantha*, Haeckel.

*Podocyrtis pentacantha*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xvii. fig. 1.

Shell rough, with slight collar stricture. Length of the three joints = 1 : 2 : 3, breadth = 1 : 4 : 6. Cephalis subspherical, with a rudimentary conical horn. Thorax campanulate, with subregular, circular, quincuncial pores. Abdomen wider, campanulate, with a small number of very large and irregular, roundish holes. From the peristome descend five stout conical feet, which are slightly curved and divergent, nearly as long as the shell.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·06; breadth, *a* 0·025, *b* 0·08, *c* 0·11.

*Habitat.*—Fossil in Barbados.

4. *Alacorys bismarckii*, n. sp. (Pl. 65, fig. 3).

Shell spiny, with distinct collar stricture. Length of the three joints = 1 : 4 : 5, breadth = 2 : 7 : 10. Cephalis hemispherical, with a very stout, dimpled, conical horn of the same length. Thorax campanulate, spiny, with regular, circular pores. Abdomen wider, campanulate, with larger conical spines, and a small number of irregular, roundish, very large holes. From the peristome descend, nearly vertically, five very large cylindrical feet, nearly twice as long as the shell; they are S-shaped, curved, spinulate in the distal half, and armed at the proximal base with two stout conical spines, the smaller of which is directed inwards, the larger curved upwards. Dedicated to Prince Otto von Bismarck, the Reconstructor of the German Empire.

*Dimensions*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·1; breadth, *a* 0·04, *b* 0·14, *c* 0·2.

*Habitat.*—Western Tropical Pacific (north of New Guinea), Station 220, depth 1100 fathoms.

Subgenus 3. *Hexalacorys*, Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Peristome armed with six feet, three of which are primary or perradial (Podocyrtis), the three other alternate, secondary or interradial.

5. *Alacorys friderici*, n. sp. (Pl. 65, fig. 1).

Shell conical, rough, with sharp collar stricture. Cephalis subspherical, with a large, oblique, prismatic horn, twice the length. Thorax campanulate, with regular, circular pores (six to eight in its length). Abdomen wider, campanulate, with a small number of very large pores (three to four in the course of its length). Peristome with six very large divergent feet, which are about as long as the shell, cylindrical, irregularly curved. The specimen figured was observed living, with expanded pseudopodia. The central capsule exhibited four large pear-shaped lobes, filling up the shell-cavity; each contained an oil-globule in the thoracic part. The undivided cephalic part of the capsule enclosed a nucleus, from which four lobes protruded through the four collar pores into the thorax. Dedicated to Frederick the Great, the Royal Philosopher of Potsdam.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·08; breadth, *a* 0·04, *b* 0·09, *c* 0·14.

*Habitat.*—North Atlantic, Canary Islands, Lanzerote (Haeckel), surface.

6. *Alacorys guilelmi*, n. sp. (Pl. 65, fig. 2).

Shell thorny, with distinct collar stricture. Length of the three joints = 1 : 3 : 4, breadth = 2 : 5 : 8. Cephalis hemispherical, with a rudimentary conical horn. Thorax hemispherical, spiny, with regular, circular pores. Abdomen wider, campanulate, papillate, with a small number of very large circular holes. Peristome with six diverging feet, which are about as long as the shell, at the base conical, thickened, and at the distal end curved inwards, with a spinulate knob. Dedicated to the German Emperor, Wilhelm.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·08; breadth, *a* 0·03, *b* 0·1, *c* 0·16.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

7. *Alacorys hexacantha*, n. sp.

Shell thorny, with slight collar stricture. Length of the three joints = 2 : 5 : 7, breadth = 4 : 10 : 14. Cephalis flat, cap-shaped, with a rudimentary conical horn. Thorax campanulate, with regular, circular pores. Abdomen wider, campanulate, with a small number of very large polygonal pores. Peristome with six large divergent feet, which are longer than the shell, cylindrical, and slightly curved, in the proximal half convex, in the distal half concave.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·07 ; breadth, *a* 0·04, *b* 0·1. *c* 0·14.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

8. *Alacorys hexapleura*, n. sp.

Shell spiny, with distinct collar stricture. Length of the three joints = 2 : 10 : 8, breadth = 3 : 11 : 10. Cephalis hemispherical, large, hyaline, and thick-walled, with a very stout, conical horn of the same length. Thorax pear-shaped, with numerous, regular, circular pores and conical spines, the size of which increases gradually towards the deep, lumbar stricture. Abdomen truncate, conical, with irregular, roundish pores, and six very strong, straight, divergent ribs, prolonged into six short, conical feet.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·2, *c* 0·16 ; breadth, *a* 0·06, *b* 0·22, *c* 0·2.

*Habitat.*—Fossil in Barbados.

## Subgenus 4. *Octalacorys*, Haeckel.

*Definition.*—Peristome armed with eight feet, four of which are primary or perradial (corresponding to those of *Tetralacorys*), the other four alternate, secondary, or interradial.

9. *Alacorys aculeata*, Haeckel.

*Podocyrtis aculeata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xiii. fig. 3.

*Podocyrtis aculeata*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 540, Taf. xxxiii. fig. 34.

Shell spiny, with deep collar stricture. Length of the three joints = 2 : 5 : 8, breadth = 2 : 7 : 10. Cephalis subspherical, with a slender, conical horn of twice the length. Thorax campanulate, thorny, with regular, circular pores. Abdomen wider, campanulate, with a small number of very large, regular, hexagonal meshes, and stout spines in the nodal points. Peristome with eight strong conical feet, which are nearly parallel, little curved (convex at the outside), and sometimes all of the same size (equal to the length of the shell) ; at other times different, four larger alternating with four smaller feet.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·08 ; breadth, *a* 0·025, *b* 0·07, *c* 0·1.

*Habitat.*—Fossil in Barbados.

10. *Alacorys octacantha*, n. sp.

Shell spiny, with deep collar stricture. Length of the three joints = 2 : 8 : 6, breadth = 3 : 7 : 7. Cephalis ovate, with a short, conical horn. Thorax pear-shaped, spiny, with regular, circular pores, similar to *Cycladophora erinaceus*, Ehrenberg (1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xviii. fig. 2). Abdomen truncate, conical, with irregular, roundish pores, and eight stout, straight, thorny, divergent ribs of equal size, which are prolonged into eight free, conical, spiny feet of the same length.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·16, *c* 0·12; breadth, *a* 0·06, *b* 0·14, *c* 0·14.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

## Subgenus 5. *Ennealacorys*, Haeckel.

*Definition.*—Peristome armed with nine feet, three of which are primary or perradial, the other six secondary or interradial.

11. *Alacorys enneacantha*, n. sp.

Shell papillate, with slight collar stricture. Length of the three joints = 2 : 4 : 8, breadth = 3 : 6 : 9. Cephalis hemispherical, with a stout, conical horn of twice the length. Thorax campanulate, with subregular, circular pores, and small, conical papillæ. Thorax wider, campanulate, with circular pores, and conical papillæ of three times the size. Peristome with nine widely divergent, little curved, conical feet, about as long as the shell. Similar to *Podocyrtis ventricosa*, Ehrenberg (1875, *loc. cit.*, Taf. xvi. fig. 3), different mainly in the feet.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·03, *b* 0·06, *c* 0·09.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

12. *Alacorys gigas*, n. sp.

Shell thorny, with distinct collar stricture. Length of the three joints = 1 : 4 : 2, breadth = 1 : 5 : 4. Cephalis ovate, with a short, conical horn of about half the length. Thorax campanulate, thorny, with small, regular, circular pores, very similar to *Cycladophora gigas*, Ehrenberg (*loc. cit.*, 1875, p. 68, Taf. xviii. fig. 1). Abdomen truncate, conical, smooth, with irregular, roundish pores, and nine stout and straight, little divergent ribs, which are prolonged into nine cylindrical, pointed feet of the same length.

*Dimensions.*—Length of the three joints, *a* 0·05, *b* 0·2, *c* 0·1; breadth, *a* 0·05, *b* 0·25, *c* 0·2.

*Habitat.*—Fossil in Barbados.

## Subgenus 6. *Polyalacorys*, Haeckel.

*Definition.*—Peristome with numerous (ten to twenty or more) prominent feet, three or four of which are primary and perradial, the others secondary and interradial.

13. *Alacorys dodecantha*, n. sp.

*? Podocyrtis schomburgkii*, var., Bury, 1862, Polycystins of Barbados, Taf. xii. fig. 3.

Shell smooth, with slight collar stricture. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 7. Cephalis ovate, with a conical horn of the same length. Thorax campanulate, with regular, circular pores. From its margin arise twelve stout, little curved, radial beams, which are widely divergent, and connected in the middle part by a transverse circular ring, so that the abdomen exhibits twelve large triangular holes, and at the peristome, alternating with these, twelve free conical feet of the same length.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·09, *c* 0·11; breadth, *a* 0·03, *b* 0·12, *c* 0·22.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms; also fossil in Barbados.

14. *Alacorys carcinus*, n. sp. (Pl. 74, fig. 9).

*Calocyclas carcinus*, Haeckel, 1879, Atlas, *loc. cit.*

*Podocyrtis schomburgkii*, var., Bury, 1862, Polycystins of Barbados, pl. i. fig. 2; pl. xii. fig. 4.

Shell rough, with distinct collar stricture. Length of the three joints = 1 : 4 : 4, breadth = 2 : 6 : 6. Cephalis hemispherical, with a large, cylindrical, bent spine of three times the length. Thorax inflated, campanulate, with large, regular, circular pores. Abdomen truncate, conical, with three to four transverse rows of regular, square pores, produced by eighteen divergent, straight ribs, which are connected by three to four horizontal rings. Distal end of the ribs prolonged into eighteen slender, conical feet, which are about as long as the thorax and slightly curved inwards.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·08; breadth, *a* 0·05, *b* 0·12, *c* 0·12.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms; also fossil in Barbados.

15. *Alacorys polyacantha*, n. sp.

Shell spiny, with deep collar stricture. Length of the three joints = 3 : 9 : 10, breadth = 4 : 12 : 16. Cephalis hemispherical, with a stout conical horn of the same length. Thorax campanulate, with regular, circular pores and conical spines, increasing in size towards the deep lumbar stricture. Abdomen truncate, conical, with twenty to thirty divergent, straight ribs, which are connected by four to six transverse rings, and prolonged into free conical feet of half the length. Therefore four to six transverse rings of regular, square pores occur.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·1; breadth, *a* 0·04, *b* 0·12, *c* 0·16.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

16. *Alacorys ornata*, Haeckel.

*Cryptoprora ornata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. v. fig. 8.

Shell ovate, smooth, without external strictures, but with two internal annular septa. Length f the three joints = 3 : 5 : 4, breadth = 3 : 6 : 5. Cephalis subspherical, partly enclosed by the uppermost part of the thorax, without horn, or with a small rudimentary horn. Pores subregular,

circular, half as broad in the cephalis as in the two other joints. Thorax campanulate. Abdomen truncate, with eighteen to twenty-four parallel, vertical, longitudinal ribs, which are prolonged into slender, free, conical feet of the same length. (This remarkable species may be derived from *Carpocanium* by apposition of a third joint.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·04; breadth, *a* 0·03, *b* 0·06, *c* 0·05.

*Habitat.*—Fossil in Barbados.

## Genus 604. *Cycladophora*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theophormida (vel Tricyrtida multiradiata aperta) with four to six or more radial ribs in the abdomen, the terminal mouth of which is truncate, without feet.

The genus *Cycladophora* differs from the preceding *Alacorys*, its probable ancestral genus, in the absence of free terminal feet, the radial ribs of the abdomen being connected by transverse beams throughout their whole length. The number of the regularly disposed ribs (four to six or more) may also here be used for the distinction of different subgenera.

### Subgenus 1. *Lampterium*, Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Abdomen with four radial ribs, opposite in pairs in two meridian planes, perpendicular one to another.

#### 1. *Cycladophora gœtheana*, n. sp. (Pl. 65, fig. 5).

Shell shaped like a lantern, with two sharp strictures. Length of the three joints = 1 : 2 : 12, breadth = 1 : 4 : 7. Cephalis hemispherical, with a slender pyramidal horn of three times the length. Thorax twice as large, thorny, hemispherical, with regular, circular pores. Abdomen very long, nearly four-sided prismatic, with four superior smaller, and four inferior larger holes; the former separated by four short, divergent, perradial, the latter by four long, parallel, vertical, interradial bars. Mouth square, four-lobed. Dedicated to Wolfgang Goethe.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·24; breadth, *a* 0·03, *b* 0·07, *c* 0·1 to 0·14.

*Habitat.*—Central Pacific, Stations 265 to 269, depth 2550 to 2900 fathoms.

#### 2. *Cycladophora tetrapleura*, n. sp.

Shell very similar to the preceding species, but differing in the following characters: Cephalis conical, with a horn of the same length. Thorax campanulate. Four ribs of the abdomen not

[1] *Cycladophora* = Bearing a female robe; κυκλάς, φόρος.

parallel and vertical, but more or less divergent. Length of the three joints = 1 : 2 : 8, breadth = 1 : 2 : 4. Whole shell slender, pyramidal. Mouth square, four-lobed.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·24; breadth, *a* 0·03, *b* 0·06, *c* 0·12.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

### 3. *Cycladophora lanterna*, n. sp.

Shell very similar to the two preceding species, but differing in the following characters. Cephalis subspherical, with a thick, pyramidal horn of the same breadth, and three times the length. Thorax hemispherical, with circular, hexagonally-framed pores. Abdomen ovate, with four convex ribs, and twelve large holes, four superior smaller pentagonal, four intermediate very large, ovate, and four inferior, small, triangular holes. Mouth little constricted, nearly circular.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·22; breadth, *a* 0·025, *b* 0·08, *c* 0·11.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Subgenus 2. *Lamptidium*, Haeckel.

*Definition.*—Abdomen with six radial ribs (three primary or perradial, and three alternate, secondary or interradial).

### 4. *Cycladophora hexapleura*, n. sp.

*Lanterna chinensis*, Bury, 1862, Polycystins of Barbados, pl. xiii. fig. 7.

Shell shaped like a lantern, with six sides and two sharp strictures. Length of the three joints = 1 : 2 : 8, breadth = 1 : 2 : 4. Cephalis hemispherical, with a conical spine of the same length. Thorax twice as large, hemispherical, with regular, circular pores. Abdomen nearly six-sided prismatic, with six descending, little curved ribs, and eighteen large holes between them; six superior holes interradial, ovate, six intermediate holes very large, perradial, ovate, six inferior holes triangular, interradial. Mouth six-lobed.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·16; breadth, *a* 0·03, *b* 0·06, *c* 0·1.

*Habitat.*—Fossil in Barbados.

### 5. *Cycladophora pyramidalis*, n. sp.

*Podocyrtis* sp., Bury, 1862, Polycystins of Barbados, pl. xii. fig. 2.

Shell slender, pyramidal, with six sides and two slight strictures. Length of the three joints = 1 : 4 : 12, breadth = 1 : 4 : 8. Cephalis subspherical, with a conical horn of twice the length. Thorax conical, with regular, circular pores. Abdomen truncate, pyramidal, with six strong, divergent, straight ribs, which are connected by five to six transverse, hexagonal rings; therefore

six longitudinal rows of large, roundish, quadrangular meshes (four to five meshes in each row). Mouth hexagonal.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·1, *c* 0·3 ; breadth, *a* 0·03, *b* 0·1, *c* 0·2.

*Habitat.*—Fossil in Barbados.

### 6. *Cycladophora spinosa*, n. sp.

Shell spiny, with two deep strictures. Length of the three joints = 1 : 4 : 3, breadth = 1 : 5 : 4. Cephalis subspherical, with a stout conical horn of the same length. Thorax ovate, with regular, circular pores, and numerous conical spines. Abdomen truncate, conical, with irregular, roundish pores, and six strong, divergent ribs. Mouth circular.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·12, *c* 0·09 ; breadth, *a* 0·03, *b* 0·15, *c* 0·12.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms ; fossil in Barbados.

## Subgenus 3. *Lamptonium*, Haeckel.

*Definition.*—Abdomen with nine radial ribs (three primary or perradial, and six secondary or interradial).

### 7. *Cycladophora enneapleura*, n. sp.

Shell spiny, with two sharp strictures. Length of the three joints = 1 : 5 : 3, breadth = 2 : 7 : 4. Cephalis hemispherical, with a conical horn of twice the length. Thorax campanulate, with regular, circular pores, and conical thorax. Abdomen cylindrical, with nine straight, parallel ribs, and irregular, roundish pores. Mouth circular. (Similar to *Clycladophora gigas*, Ehrenberg, 1875, *loc. cit.*, Taf. xviii. fig. 1, but differing in the possession of nine abdominal ribs.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·15, *c* 0·1 ; breadth, *a* 0·06, *b* 0·2, *c* 0·12.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

### 8. *Cycladophora nonagona*, n. sp.

Shell spiny, with two distinct strictures. Length of the three joints = 3 : 10 : 7, breadth = 2 : 9 : 8. Cephalis pear-shaped, with a stout pyramidal horn of the same length. Thorax pear-shaped, with regular, circular pores, and conical horns, increasing in size towards the base. Abdomen truncate, pyramidal, with nine straight, spinulate ribs, and nine even faces between them, with irregular, roundish pores. Mouth nonagonal.

*Dimensions.*—Length of the three joints, *a* 0·06, *b* 0·2, *c* 0·14 ; breadth, *a* 0·05, *b* 0·18, *c* 0·16.

*Habitat.*—Fossil in Barbados.

## Subgenus 4. *Cyclampterium*, Haeckel.

*Definition.*—Abdomen truncate, conical or campanulate, with numerous (ten to twenty or more) divergent ribs. Mouth wide open, truncate.

### 9. *Cycladophora pantheon*, n. sp. (Pl. 68, fig. 3).

Shell dome-shaped, with slight collar and deep lumbar stricture. Length of the three joints = 1 : 6 : 5, breadth = 1 : 7 : 8. Cephalis small, with a conical horn of the same length. Thorax cupola-shaped, with large, regular, circular pores, and numerous pyramidal tubercles. Abdomen with twelve (sometimes eleven or thirteen) slender, divergent ribs, which are connected at equal distances by four to six horizontal rings, and so produce twelve longitudinal rows of large, regular, square meshes.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·12, *c* 0·1; breadth, *a* 0·03, *b* 0·14, *c* 0·15.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

### 10. *Cycladophora dodecapleura*, n. sp.

Shell cupola-shaped, with two deep strictures. Length of the three joints = 2 : 5 : 6, breadth = 2 : 7 : 10. Cephalis hemispherical, with a conical horn of twice the length. Thorax subspherical, truncate at both poles, thorny, with regular, circular pores. Abdomen in the upper half with a coronal of twelve large ovate holes, separated by twelve divergent, slender ribs, in the lower half with curved, convergent prolongations of the twelve ribs, and numerous small, irregular, roundish pores.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·05, *c* 0·06; breadth, *a* 0·02, *b* 0·07, *c* 0·1.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 11. *Cycladophora campanula*, n. sp.

Shell campanulate, with two slight strictures. Length of the three joints = 2 : 4 : 5, breadth = 2 : 6 : 10. Cephalis ovate, with a conical horn of the same length. Thorax campanulate, rough, with regular, circular pores. Abdomen dilated, with fifteen to twenty slender, divergent, little curved ribs, which are connected by two or three horizontal rings, and from two or three transverse rows of large, roundish, square pores.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·08, *c* 0·1; breadth, *a* 0·04, *b* 0·12, *c* 0·2.

*Habitat.*—North Atlantic, Bermuda, surface; also fossil in Barbados.

### 12. *Cycladophora spatiosa*, Ehrenberg.

*Cycladophora spatiosa*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xviii. figs. 5, 6.

Shell campanulate, with two slight strictures. Length of the three joints = 2 : 6 : 9, breadth = 3 : 8 : 14. Cephalis subspherical, with a conical horn of the same length. Thorax campanulate,

smooth, with regular, circular pores. Abdomen truncate, conical, with sixteen to twenty-four divergent ribs, which are straight or slightly curved, and connected by from four to six transverse, circular rings. The large regular meshes, so produced, form sixteen to twenty-four longitudinal series, and are rounded in the upper, square in the lower transverse rows.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·09; breadth, *a* 0·03, *b* 0·08, *c* 0·14.

*Habitat.*—Fossil in Barbados.

### 13. *Cycladophora favosa*, n. sp. (Pl. 62, figs. 5, 6).

Shell dome-shaped, without collar stricture, but with a deep lumbar stricture. Cephalis flat, cap-shaped, without horn, or with a rudimentary conical horn, with small circular pores. Length of the three joints = 1 : 4 : 3, breadth = 2 : 5 : 4. Thorax subspherical, rough, with regular, circular, hexagonally-framed pores. Abdomen truncate, conical, with eighteen to twenty-four prominent ribs; between every two ribs only two or three ovate pores occur. Mouth circular, with eighteen to twenty-four teeth. The shape of the abdomen is rather variable (figs. 5, 6).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·06; breadth, *a* 0·04, *b* 0·09, *c* 0·07.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Subgenus 5. *Cyclamptidium*, Haeckel.

*Definition.*—Abdomen nearly cylindrical or prismatic, with numerous (ten to twenty or more) straight, vertical, parallel ribs. Mouth wide open, truncate.

### 14. *Cycladophora fenestrata*, n. sp. (Pl. 68, fig. 2).

Shell rough, with two slight strictures. Length of the three joints = 1 : 5 : 5, breadth = 1 : 6 : 5. Cephalis conical, with a conical, dimpled horn of twice the length. Thorax nearly spherical, with regular, circular pores, and small conical spines. Abdomen cylindrical, with eighteen stout, parallel, vertical ribs, which are connected by six to eight horizontal, circular rings; therefore regular transverse and longitudinal rows of square or circular pores occur. Mouth truncate, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·1; breadth, *a* 0·03, *b* 0·12, *c* 0·1.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### 15. *Cycladophora stiligera*, Ehrenberg.

*Cycladophora stiligera*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xviii. fig. 3.

Shell smooth, with two distinct strictures. Length of the three joints = 2 : 7 : 8, breadth = 2 : 9 : 7. Cephalis subspherical, with a conical horn of twice the length. Thorax subspherical, smooth, with regular, circular pores. Abdomen cylindrical, with twelve parallel, vertical ribs, which

are connected by three to four broad, horizontal rings; therefore subregular, transverse, and longitudinal rows of roundish pores are present. Mouth truncate, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·08; breadth, *a* 0·02, *b* 0·09, *c* 0·07.

*Habitat.*—Fossil in Barbados.

Genus 605. *Calocyclas*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Theophormida (vel Tricyrtida multiradiata aperta) with a simple corona of terminal feet around the truncate mouth. Abdomen not dilated, cylindrical or ovate. No ribs in the shell-wall.

The genus *Calocyclas*, and the three following closely allied genera, differ from the four preceding genera of Theophormida in the absence of radial or longitudinal ribs in the wall of the thorax and abdomen. These are completely reduced, and their terminal prolongations only remain, forming a simple or double corona around the mouth of the abdomen. They correspond therefore to *Carpocanium* and *Anthocyrtis* among the Dicyrtida. In *Calocyclas* the corona is simple. The mouth is not dilated, but often constricted, and the abdomen is cylindrical or ovate, not conical. The teeth of the corona are usually vertical or convergent.

Subgenus 1. *Calocycletta*, Haeckel.

*Definition.*—Thorax and abdomen smooth, without spines or thorns.

1. *Calocyclas veneris*, n. sp. (Pl. 74, fig. 5).

Shell smooth, with two distinct strictures. Length of the three joints = 1 : 2 : 2, breadth = 1 : 4 : 3. Cephalis ovate, with a large, triangular, prismatic horn of three times the length. Thorax hemispherical; abdomen cylindrical; both with regular, circular pores of equal size. Mouth truncate, with a corona of nine to twelve vertical, lamellar feet, which are as long as the abdomen, rectangular, twice as broad as their distance apart, and truncate at the end.

*Dimensions.*—Length of the three joints, *a* 0·03 to 0·04, *b* 0·06 to 0·08, *c* 0·04 to 0·06; breadth, *a* 0·03 to 0·04, *b* 0·09 to 0·11, *c* 0·08 to 0·1.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, many stations; surface, and in various depths.

2. *Calocyclas virginis*, n. sp. (Pl. 74, fig. 4).

Shell smooth, with distinct collar, but indistinct lumbar stricture. Length of the three joints = 1 : 2 : 1, breadth = 1 : 4 : 3. Cephalis ovate, with a slender, conical horn, little shorter than the

[1] *Calocyclas* = Beautiful female robe; καλός, κυκλάς.

shell. Thorax subspherical. Abdomen nearly cylindrical, little contracted towards the peristome. Pores regular, circular, twice as broad in the thorax as in the abdomen, where they are separated by slight longitudinal ribs. Corona of the peristome composed of sixteen to twenty-four vertical, lamellar feet, which are longer than the abdomen, rectangular, and truncate at the end.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·08, *c* 0·05; breadth, *a* 0·03, *b* 0·11, *c* 0·09.

*Habitat.*—Central Pacific, Station 225, depth 4475 fathoms.

### 3. *Calocyclas minervæ*, n. sp.

Shell smooth, with two deep strictures, similar to *Cycladophora stiligera*. Length of the three joints = 1 : 4 : 3, breadth = 1 : 4 : 3. Cephalis subspherical, with a large, conical horn of three times the length. Thorax subspherical, with small, regular, circular pores. Abdomen cylindrical, with truncate mouth and few irregular pores of different sizes, commonly arranged in three or four subregular, transverse rows, with large intervening distances. Peristome with a corona of twelve to twenty vertical, lamellar feet, which are about as long as the abdomen, and truncate at the end (in Ehrenberg's figure these are broken off).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·06; breadth, *a* 0·02, *b* 0·09, *c* 0·07.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 4. *Calocyclas amicæ*, n. sp. (Pl. 74, fig. 2).

Shell smooth, with two slight strictures. Length of the three joints = 2 : 4 : 5, breadth = 2 : 5 : 5. Cephalis subspherical, with a pyramidal horn of the same length. Thorax campanulate-conical; abdomen nearly cylindrical; both with small, subregular, circular pores. Peristome with a corona of twelve to fifteen small, triangular feet, only as large as the thickness of the shell-wall, and separated by distances of twice the size.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·08, *c* 0·1; breadth, *a* 0·04, *b* 0·1, *c* 0·1.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

### 5. *Calocyclas sacerdotis*, n. sp.

Shell smooth, with two deep strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 3 : 3. Cephalis ovate, with a pyramidal horn of three times the length. Thorax campanulate, conical; abdomen twice the length, cylindrical; both with small, regular, circular pores. Peristome somewhat constricted, with a corona of nine to twelve conical feet, which are as long as the cephalis, and with the ends curved inwards, protecting the mouth.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·12; breadth, *a* 0·03, *b* 0·09, *c* 0·09.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

### 6. *Calocyclas vestalis*, n. sp. (Pl. 74, fig. 3).

Shell smooth, with two deep strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 3. Cephalis subspherical, with a pyramidal horn of twice the length. Thorax campanulate; abdomen

nearly cylindrical; both with regular, hexagonal pores, three times as broad as the bars. Peristome constricted, half as broad as the abdomen, with a corona of nine conical, vertical feet as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·07, *c* 0·1; breadth, *a* 0·035, *b* 0·1, *c* 0·1.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Subgenus 2. *Calocyclissa*, Haeckel.

*Definition.*—Thorax spiny or thorny; abdomen smooth.

### 7. *Calocyclas turris*, Ehrenberg.

*Calocyclas turris*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xviii. fig. 7.

Shell with two sharp strictures. Length of the three joints = 1 : 4 : 4, breadth = 1 : 5 : 4. Cephalis hemispherical, with a stout conical horn of the same length. Thorax subspherical, thorny with small, regular, circular, quincuncial pores. Abdomen cylindrical, smooth, nearly hyaline, with very scarce, irregular, widely scattered pores. Peristome with a corona of fifteen to twenty broad, lamellar, vertical, truncate feet, about as long as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·08; breadth, *a* 0·03, *b* 0·1, *c* 0·08.

*Habitat.*—Fossil in Barbados.

### 8. *Calocyclas hyalogaster*, n. sp.

Shell with two sharp strictures. Length of the three joints = 1 : 4 : 6, breadth = 1 : 4 : 3. Cephalis subspherical, with a conical horn of twice the length. Thorax subspherical, thorny, with regular, circular pores. Abdomen cylindrical, smooth, quite hyaline, without any pores. Peristome with a corona of twelve broad, lamellar, vertical, truncate feet, half as long as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·12; breadth, *a* 0·02, *b* 0·08, *c* 0·06.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

### 9. *Calocyclas erinaceus*, Haeckel.

*Cycladophora erinaceus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xviii. fig. 2.

Shell with two sharp strictures. Length of the three joints = 2 : 9 : 5, breadth = 3 : 9 : 5. Cephalis subspherical, rough, with a short and broad conical horn of half the length. Thorax ovate, densely covered with conical spines as long as the horn, and with regular, circular, quincuncial pores. Abdomen cylindrical, smooth, with irregular roundish pores of different sizes. Peristome with twelve to fifteen vertical, broad, lamellar, truncate feet half as long as the abdomen (in Ehrenberg's figure these are broken off).

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·18, *c* 0·1; breadth, *a* 0·06, *b* 0·18, *c* 0·1.

*Habitat.*—Fossil in Barbados.

10. *Calocyclas gigas*, Haeckel.

*Cyrtadophora gigas*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xviii. fig. 1.

Shell with two sharp strictures. Length of the three joints = 2 : 5 : 3, breadth = 2 : 6 : 4. Cephalis subspherical, rough, with a short and broad conical horn of half the length. Thorax subspherical, campanulate, thorny, with subregular, circular pores (smaller and more numerous than in the preceding). Abdomen cylindrical, smooth, with a small number of sparsely disposed, roundish, irregularly scattered pores. Peristome with twenty to thirty short, lamellar, truncate, vertical feet about half as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·06, *b* 0·15, *c* 0·09; breadth, *a* 0·06, *b* 0·18, *c* 0·12.

*Habitat.*—Fossil in Barbados.

## Subgenus 3. *Calocycloma*, Haeckel.

*Definition.*—Thorax smooth; abdomen spiny or thorny.

11. *Calocyclas casta*, n. sp. (Pl. 73, fig. 10).

Shell ovate, with two sharp strictures. Length of the three joints = 1 : 2 : 8, breadth = 2 : 4 : 8. Cephalis hemispherical, with a strong pyramidal horn of twice the length. Thorax campanulate, smooth, with small, regular, circular pores. Abdomen inflated, subspherical, covered with large conical spines, and large intervening circular pores (four times as broad as the thoracic pores). Mouth constricted, only one-third as broad as the abdomen, with a peristome of nine to twelve conical vertical feet as long as the abdominal spines. (In the specimen figured they were broken off.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·04, *c* 0·15; breadth, *a* 0·04, *b* 0·08, *c* 0·15.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

12. *Calocyclas pudica*, n. sp.

Shell ovate, with two distinct strictures. Length of the three joints = 1 : 3 : 8, breadth = 1 : 4 : 6. Cephalis subspherical, with a conical horn of three times the length. Thorax and abdomen nearly of the same shape as in the preceding species, but more slender, and the regular, circular pores of the abdomen only twice as broad as the thoracic pores. Conical spines of the abdomen only half as large, but more numerous. Peristome constricted, half as broad as the abdomen, with sixteen to twenty short, conical, vertical feet as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·16; breadth, *a* 0·025, *b* 0·08, *c* 0·12.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Subgenus 4. *Calocycloma*, Haeckel.

*Definition.*—Thorax and abdomen spiny or thorny.

13. *Calocyclas parthenia*, n. sp. (Pl. 74, fig. 1).

Shell nearly ovate, with thorny surface, and two slight strictures. Length of the three joints = 1 : 2 : 4, breadth = 2 : 4 : 5. Cephalis hemispherical, armed with numerous short, conical thorns, and with a pyramidal, very large, vertical horn as long as the thorax, and on the basal half as broad as the cephalis. Thorax hemispherical, separated by a slight stricture from the broader, barrel-shaped abdomen, which is a little constricted at the mouth. Teeth of the coronal about twenty, triangular, short, little divergent. Pores circular, somewhat irregular in size, three to four times as broad as the bars, in all three joints nearly of the same shape.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·11 ; breadth, *a* 0·05, *b* 0·1, *c* 0·12.

*Habitat.*—Indian Ocean, Cocos Islands, surface (Rabbe).

14. *Calocyclas aspasia*, n. sp.

Shell ovate, conical, with two deep strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 5. Cephalis subspherical, with a conical horn of twice the length. Thorax and abdomen nearly of the same shape as in the preceding species, but covered with longer conical spines, less numerous, and twice as long as the diameter of the subregular, circular pores. Mouth more constricted, and armed with a coronal of twelve to sixteen broad, lamellar feet, as long as the cephalis, and similar to those of *Calocyclas puella* (Pl. 74, fig. 5).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·08 ; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

15. *Calocyclas monumentum*, n. sp. (Pl. 73, fig. 9).

Shell nearly conical, with two very deep strictures, everywhere covered with long, bristle-shaped, divergent spines, about as long as the thorax. Length of the three joints = 1 : 2 : 2, breadth = 1 : 4 : 6. Cephalis nearly spherical, with a very large, three-sided pyramidal horn of twice the length. Thorax and abdomen of similar form, campanulate, with a lower cylindrical, and an upper truncate, conical part. Pores irregular, roundish, in the smaller thorax of slightly different sizes, in the larger abdomen three to four transverse rows of larger pores (six to eight in each row) are separated by numerous much smaller pores. Peristome wide open, with a coronal of twelve large, triangular, vertical feet, nearly as long as the abdomen ; in the base of each foot a large, roundish, triangular pore.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·6 ; breadth, *a* 0·04, *b* 0·12, *c* 0·18.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 606. *Clathrocyclas*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theophormida (vel Tricyrtida multiradiata aperta) with a simple corona of terminal feet around the dilated mouth. Abdomen dilated, truncate-conical, or discoidal. No ribs in the shell-wall.

[1] *Clathrocyclas* = Fenestrated female robe ; κλῆθρα, κυκλάς.

The genus *Clathrocyclas* differs from the preceding closely allied *Calocyclas* in the dilated mouth and the flatter form of the abdomen, which is usually truncate, conical, or nearly discoidal. The conical thorax is often separated from the flat abdomen by an elegant ribbon of small quadrangular pores. The feet or teeth of the terminal corona are divergent, or even horizontally expanded, whilst in *Calocyclas* they are usually vertical or somewhat convergent.

## Subgenus 1. *Clathrocyclia*, Haeckel.

*Definition.*—Shell highly conical, often ovate or slenderly campanulate. Cephalis commonly with a single horn.

### 1. *Clathrocyclas principessa*, n. sp. (Pl. 74, fig. 7).

Shell ovate, with two distinct strictures. Length of the three joints = 1 : 2 : 1, breadth = 1 : 2 : 2. Cephalis hemispherical, large, with a pyramidal, occipital horn of the same length. Thorax subspherical, with irregular, circular pores, about as broad as the bars. Abdomen short, widely open with a single transverse row of circular pores, and a coronal of twelve triangular, divergent feet, as long as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·03 ; breadth, *a* 0·04, *b* 0·08, *c* 0·09.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### 2. *Clathrocyclas basilea*, (Pl. 74, fig. 6).

Shell campanulate, with two deep strictures. Length of the three joints = 2 : 5 : 3, breadth = 3 : 7 : 9. Cephalis hemispherical, with an ovate, oblique horn of the same length. Thorax hemispherical, with subregular, circular pores of the same breadth as the bars. Abdomen short, with two transverse rows of the same pores, and with a coronal of sixteen to twenty ovate, divergent feet, as long as the horn.

*Dimensions.*—Length of the three joints, *a* 0·02. *b* 0·05, *c* 0·03 ; breadth, *a* 0·035, *b* 0·07, *c* 0·09.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

### 3. *Clathrocyclas fimbriata*, Haeckel.

? *Halicalyptra fimbriata*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. ii. fig. 11.

Shell campanulate, with two deep strictures. Length of the three joints = 1 : 3 : 1, breadth = 1 : 3 : 5. Cephalis hemispherical, with a conical horn of twice the length. Thorax hemispherical, in the upper half hyaline, without pores, in the lower half with four to six transverse rows of subregular, circular pores. Abdomen short, suddenly dilated, with one or two transverse rows of larger

ovate pores (six to eight in one row), and with a coronal of twelve to fifteen divergent, slender, curved feet, as long as the cephalis. (In the figure of Ehrenberg, seen half from below, the cephalis is not represented.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·02 ; breadth, *a* 0·02, *b* 0·06, *c* 0·1.

*Habitat.*—Fossil in Barbados.

4. *Clathrocyclas collaris*, n. sp. (Pl. 74, fig. 8).

Shell subconical, with two indistinct strictures. Length of the three joints = 1 : 1 : 2, breadth = 1 : 2 : 3. Cephalis hemispherical, with a triangular prismatic horn three times the length. Thorax truncate, conical, with a single transverse row of circular pores, each of which is placed in the lower end of an oblong, lanceolate, longitudinal furrow ; collar composed of fifteen to twenty such furrows. Abdomen inflated, with four to six transverse rows of circular pores, and with a coronal of nine triangular, divergent feet, longer than the collar.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·06 ; breadth, *a* 0·03, *b* 0·06, *c* 0·09.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

5. *Clathrocyclas puella*, Haeckel.

*Podocyrtis puella sinensis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xiv. fig. 3.

Shell subconical, with two indistinct strictures. Length of the three joints = 1 : 1 : 2, breadth = 1 : 2 : 3. Cephalis hemispherical, with a pyramidal horn of twice the length. Pores subregular, circular, quincuncial, in the dilated abdomen (with four to five transverse rows), twice to three times as large as in the short thorax (with two to three rows). Coronal of the wide peristome with fifteen to twenty short, triangular, divergent feet, about as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·02, *c* 0·04 ; breadth, *a* 0·02, *b* 0·04, *c* 0·06.

*Habitat.*—Fossil in Barbados.

6. *Clathrocyclas domina*, Haeckel.

*Podocyrtis domina sinensis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xiv. fig. 4.

Shell subconical, with two slight strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 4. Cephalis ovate, with a conical horn of the same length (and sometimes with some little accessory thorns at its base). Pores subregular, circular, quincuncial, in the dilated abdomen (with six to eight transverse rows), twice to four times as large as in the hemispherical thorax (with four to six rows). Coronal of the wide persistome with nine to twelve short, triangular, divergent feet, half as long as the cephalis (in Ehrenberg's figure incomplete).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08 ; breadth, *a* 0·02, *b* 0·06, *c* 0·08.

*Habitat.*—Central Pacific, Stations 263 to 268, depth 2650 to 3000 fathoms; also fossil in Barbados.

Subgenus 2. *Clathrocycloma*, Haeckel.

*Definition.*—Shell flatly conical, often widely campanulate, or nearly discoidal. Cephalis commonly with two or more horns

7. *Clathrocyclas alcmenæ*, n. sp. (Pl. 59, fig. 6).

Shell conical, with two indistinct strictures. Length of the three joints = 2 : 10 : 1, breadth = 2 : 12 : 14. Cephalis hemispherical, with two divergent, pyramidal horns; frontal horn as long as the cephalis, occipital horn of twice the length. Thorax conical, with large hexagonal meshes, increasing gradually in size towards the short abdomen, which is represented only by a single circular girdle of small, square, abdominal pores. Coronal of the peristome with twenty to thirty triangular, divergent, nearly horizontal feet, as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·01; breadth, *a* 0·02, *b* 0·12, *c* 0·14.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

8. *Clathrocyclas europæ*, n. sp. (Pl. 59, figs. 11, 12).

Shell conical, almost of the same form as the preceding nearly allied species, differing from it in the concave (not straight) outline of the flatter conical thorax, in the more rounded form of its pores, and in the subspherical form of the cephalis, bearing only a single conical horn of the same length. Length of the three joints = 2 : 8 : 1, breadth = 2 : 12 : 14. In fig. 11 the cephalis is broken off, so that the four cortinar pores are visible (two smaller jugular and two larger cardinal pores, separated by two coracal beams).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·01; breadth, *a* 0·02, *b* 0·12, *c* 0·14.

*Habitat.*—Mediterranean, Corfu (Haeckel), surface.

9. *Clathrocyclas semeles*, n. sp. (Pl. 58, fig. 5).

Shell conical-campanulate, with two distinct strictures. Length of the three joints = 2 : 8 : 1, breadth = 2 : 8 : 10. Cephalis hemispherical, with three divergent, conical horns (the caudal horn, directed downwards, much longer than the occipital and frontal horns). Pores of the thorax large, roundish. Abdomen (as in the two preceding species) with only a single circle of forty to fifty small square pores. Coronal with about the same number of short, triangular, almost horizontally divergent feet.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·01; breadth, *a* 0·02, *b* 0·08, *c* 0·1.

*Habitat.*—Central Pacific, Station 271, surface.

10. *Clathrocyclas danaës*, n. sp. (Pl. 59, figs. 13, 14).

Shell flatly conical, with straight outline (as in *Clathrocyclas alcmenæ*, Pl. 59, fig. 6). Length of the three joints = 1 : 5 : 1, breadth = 2 : 8 : 1. Cephalis hemispherical, with a single, short, conical,

oblique horn (broken off in the specimen figured). Pores of the thorax polygonal, increasing gradually in size towards the girdle (in three to four circles.) Abdomen nearly horizontally expanded, with two rows of pores, the inner with very small and numerous square pores, the outer with twenty to thirty much larger quadrangular pores. Coronal of the peristome with the same number of short, divergent feet, alternating with the larger pores.

*Dimensions.*—Length of the three joints. *a* 0·02, *b* 0·1, *c* 0·02; breadth, *a* 0·04, *b* 0·15, *c* 0·2.

*Habitat.*—North Atlantic, Canary Islands (Lanzerote), Station 354, surface.

11. *Clathrocyclas jonis*, n. sp. (Pl. 59, fig. 9).

Shell campanulate, with two slight strictures. Length of the three joints = 1 : 5 : 2, breadth = 1 : 6 : 8. Cephalis small, hemispherical, with two divergent, conical horns of nearly equal length. Pores of the thorax polygonal, increasing in size towards the girdle; in the upper half filled up by an extremely fine and delicate cobweb-like network. Abdomen with two rows of pores, of the same shape as in the preceding species, also with equal coronal.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·03; breadth, *a* 0·02, *b* 0·12, *c* 0·16.

*Habitat.*—Central Pacific, Station 274, surface.

12. *Clathrocyclas latonæ*, n. sp. (Pl. 59, fig. 7).

Shell campanulate, very similar to the preceding species, but flatter and different in the larger cephalis, bearing only a single oblique horn. All the polygonal pores of the thorax are filled out by delicate cobweb-like network. Length of the three joints = 1 : 3 : 1, breadth = 1 : 4 : 6. Abdomen with three circular rows of quadrangular pores; first very small and numerous, second of median size, third very large. Coronal with thirty to forty short triangular feet.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·03; breadth, *a* 0·03, *b* 0·12, *c* 0·18.

*Habitat.*—Tropical Atlantic, Station 325, surface.

13. *Clathrocyclas coscinodiscus*, n. sp. (Pl. 58, figs. 3, 4).

Shell flatly campanulate, with two distinct strictures. Length of the three joints = 1 : 5 : 2, breadth = 1 : 8 : 10. Cephalis hemispherical, with two divergent, pyramidal horns of the same length. Thorax with concave outline, with numerous hexagonal pores, gradually increasing in size towards the girdle, except the outermost row (inside the girdle), which is composed of very small, square pores. Abdomen (outside the girdle) with three rows of pores; first with small, second with median, third with large pores. Coronal with eighty to one hundred short, divergent feet.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·03; breadth, *a* 0·025, *b* 0·16, *c* 0·2.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

14. *Clathrocyclas cassiopeiæ*, n. sp. (Pl. 59, fig. 5).

Shell flatly campanulate, with two slight strictures. Length of the three joints = 2 : 4 : 3, breadth = 2 : 6 : 8. Cephalis ovate, thorny, with a pyramidal horn of the same length, and several smaller accessory horns. Thorax smooth, with irregular, polygonal pores of nearly equal size. Abdomen spiny, with three to four irregular rows of similar pores. Coronal with sixty to ninety or more irregularly and obliquely divergent feet, little larger than the abdominal spines.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·08, *c* 0·06; breadth, *a* 0·03, *b* 0·12, *c* 0·16.

*Habitat.*—Indian Ocean, Madagascar, Rabbe, surface.

## Genus 607. *Lamprocyclas*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition*—Theophormida (vel Tricyrtida multiradiata aperta) with a double corona of solid terminal feet around the mouth. No ribs in the shell-wall.

The genus *Lamprocyclas* differs from *Calocyclas*, its ancestral form, in the duplication of the terminal corona. Usually the feet or teeth of the lower corona are convergent and curved inwards, whilst the teeth of the upper corona are divergent and curved outwards. Sometimes above the latter a third corona begins to be developed. The whole shell is more or less conical, very thick-walled, with a large and stout apical horn.

### Subgenus 1. *Lamprocyclia*, Haeckel.

*Definition.*—Feet of the peristome simple, not branched.

1. *Lamprocyclas nuptialis*, n. sp. (Pl. 74, fig. 15).

Shell campanulate, nearly smooth, with two slight strictures. Length of the three joints = 1 : 2 : 2, breadth = 1 : 3 : 4. Cephalis ovate, with a very large, three-sided prismatic horn, nearly as long as the shell. Thorax and abdomen gradually dilated, with regular, circular, double-edged pores. Outer coronal of the peristome with twelve to fifteen divergent feet, inner with as many subvertical, triangular, little curved feet, about as long as the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·06; breadth, *a* 0·03, *b* 0·09, *c* 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Lamprocyclas maritalis*, n. sp. (Pl. 74, figs. 13, 14).

Shell campanulate, very similar to the preceding species in form and fenestration, but not so slender and with different peristome. Length of the three joints = 4 : 5 : 6, breadth = 4 : 10 : 13. Cephalis subspherical, with a very stout, pyramidal horn of twice the length, the edges of which are

[1] *Lamprocyclas* = Splendid female robe; λαμπρός, κυκλάς.

spirally convoluted. Outer coronal of the peristome with twelve to fifteen short, divergent feet, inner with as many convergent, longer feet.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·05, *c* 0·06; breadth, *a* 0·04, *b* 0·1, *c* 0·13.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Lamprocyclas deflorata*, n. sp. (Pl. 74, fig. 10).

Shell ovate, smooth, with deep collar, but indistinct lumbar stricture; very similar to the two preceding species, but with different horn and peristome. Length of the three joints = 3 : 5 : 8, breadth = 3 : 10 : 13. Cephalis subspherical, with a pyramidal horn of twice the length, the three faces of which are deeply concave. Thoracic pores half as large as the abdominal, both subregular, double-edged. Outer coronal of the wide peristome with nine short, triangular, subvertical feet, inner with nine larger, horizontal feet, lying in the plane of the wide mouth.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·08; breadth, *a* 0·03, *b* 0·1, *c* 0·13.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

4. *Lamprocyclas saltatricis*, n. sp. (Pl. 74, fig. 16).

Shell conical, rough, with two slight strictures. Length of the three joints = 2 : 2 : 3, breadth = 1 : 4 : 6. Cephalis ovate, with a large, prismatic horn, half as long as the shell. Pores subregular, circular, not double-edged, three times as broad in the inflated abdomen as in the hemispherical thorax. Outer coronal of the wide peristome with twelve to fifteen divergent feet, inner with fifteen to twenty conical feet, which are curved inwards nearly horizontally.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·05, *c* 0·07; breadth, *a* 0·025, *b* 0·1, *c* 0·15.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

5. *Lamprocyclas reginæ*, n. sp. (Pl. 74, figs. 11, 12).

Shell campanulate, with two slight strictures. Length of the three joints = 2 : 3 : 3, breadth = 2 : 5 : 6. Cephalis subcylindrical, with about fifteen longitudinal rows of circular pores, separated by prominent, parallel crests, and with a very large sword-like horn, nearly as long as the shell. Thorax hemispherical, smooth, with elegant, circular, hexagonally-framed pores. Abdomen dilated, with similar but larger pores, armed with hook-shaped spines. The two inferior rows of these hooks form the double coronal of the peristome; the feet of the outer are curved downwards, of the inner inwards.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·06, *c* 0·06; breadth, *a* 0·04, *b* 0·1, *c* 0·12.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

6. *Lamprocyclas ægles*, Haeckel.

*Podocyrtis ægles*, Ehrenberg, 1854, Mikrogeol., Taf. xxxv. B. B iv. fig. 18.

Shell campanulate, conical, thorny, with two deep strictures. Length of the three joints = 3 : 5 : 5, breadth = 3 : 8 : 11. Cephalis ovate, with a stout, three-sided prismatic horn of twice the

length. Pores subregular, circular, twice as broad in the inflated abdomen as in the campanulate thorax, and four times as broad as in the cephalis. Outer coronal of the wide peristome with fifteen to twenty conical, divergent feet, inner coronal with a smaller number of vertical, parallel, divergent feet.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·05; breadth, *a* 0·03, *b* 0·08, *c* 0·11.

*Habitat.*—North Atlantic, depth 1400 fathoms (Berrymann).

### Subgenus 2. *Lamprocycloma*, Haeckel.

*Definition.*—Feet of the peristome forked or branched.

#### 7. *Lamprocyclas bajaderæ*, n. sp.

Shell campanulate, very similar to the preceding species, but with stronger spines on the abdomen and with different peristome. Length of the three joints = 2 : 2 : 3, breadth = 2 : 6 : 8. Cephalis equal to that of *Lamprocyclas maritalis* (Pl. 74, figs. 13, 14). Outer coronal of the peristome with fifteen to twenty divergent, pyramidal feet, half as long as the horn; inner coronal with as many longer, vertical feet, which are irregularly forked or branched.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·04, *c* 0·06; breadth, *a* 0·04, *b* 0·12, *c* 0·16.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

### Genus 608. *Diplocyclas*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theophormida (vel Tricyrtida multiradiata aperta) with a double corona of radial solid feet, an upper around the lumbar stricture, a lower around the mouth. No ribs in the shell-wall.

The genus *Diplocyclas* differs from all the other Theophormida in the possession of a double coronal of radial teeth, an upper between thorax and abdomen, and a lower around the terminal mouth of the latter; it may be regarded as an *Anthocyrtis*, which has formed an abdomen, and repeated the terminal armature. The cephalis bears a single or double apical horn.

#### 1. *Diplocyclas bicorona*, n. sp. (Pl. 59, fig. 8).

Shell slender, campanulate. Length of the three joints = 1 : 3 : 2, breadth = 1 : 4 : 4. Cephalis subspherical, with two divergent horns; the occipital of the same length and forked, the frontal shorter and simple. Thorax campanulate, with six to eight transverse rows of double-edged roundish pores of increasing size. Abdomen cylindrical, with three transverse rows of large poly-

[1] *Diplocyclas* = Female robe with a double girdle; διπλόος, κυκλάς.

gonal pores, and a terminal row of very small square pores. Lumbar and terminal coronals of similar shape, each with twenty to thirty short divergent feet.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·04; breadth, *a* 0·025, *b* 0·08, *c* 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Diplocyclas bicincta*, n. sp.

Shell campanulate, in general of the same form as, and similar fenestration to, the preceding species but not so slender, and with different proportions. Length of the three joints = 1 : 4 : 2, breadth = 2 : 5 : 5. Cephalis hemispherical, with a single, conical, simple horn. Pores of the thorax hexagonal, of increasing size (in eight to ten transverse rows). Abdomen with smaller square pores (in four to six rows). The two coronals of the same shape as in Pl. **59**, fig. 8.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·04; breadth, *a* 0·04, *b* 0·1, *c* 0·1.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

3. *Diclocyclas bizonalis*, n. sp.

Shell subconical, with indistinct collar and distinct lumbar stricture. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis hemispherical, with two divergent conical horns of equal size. Thorax conical, with small, irregular, roundish, double-edged pores, and a terminal corona of about nine very large pores. Abdomen truncate, conical, with three to four transverse rows of roundish, quadrangular, very large pores. Lumbar and terminal coronals of similar shape, each with twelve to fifteen triangular divergent feet.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·06; breadth, *a* 0·02, *b* 0·06, *c* 0·08.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

## Subfamily 2. THEOPHÆNIDA, Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Phormocyrtida with the basal mouth of the shell fenestrated (vel Tricyrtida multiradiata clausa).

## Genus 609. *Hexalatractus*,[1] n. gen.

*Definition.*—Theophænida (vel Tricyrtida multiradiata clausa) with six lateral wings on the abdomen.

The genus *Hexalatractus*, and the following genus *Theophæna*, represent together the small subfamily Theophænida, or those Tricyrtida in which the terminal mouth of the shell is closed by lattice-work, and six or nine lateral apophyses indicate a multiradiate structure. The shell is more or less ovate or spindle-shaped, tapering towards

[1] *Hexalatractus* = Spindle with six wings; ἕξ ἀλα, ἀτρακτος.

both poles, and resembles greatly the triradiate *Rhopalocanium*. It may be derived from the latter by interpolation of three secondary or interradial wings between the three primary or perradial apophyses.

1. *Hexalatractus sexalatus*, n. sp.

Shell ovate, smooth, with two distinct strictures. Length of the three joints = 3 : 6 : 9, breadth = 4 : 9 : 8. Cephalis subspherical, with a pyramidal horn of twice the length. Thorax campanulate; abdomen inversely conical; both with subregular, circular pores. Six divergent wings arise, beginning from the collar stricture, from the upper half of the shell, with broad triangular base; they are little curved downwards, with the convexity outside, and gradually tapering towards the distal end; the latter lies in the same horizontal plane as the basal apex of the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·09; breadth, *a* 0·04, *b* 0·09, *c* 0·08.

*Habitat.*—Central Pacific, Stations 263, depth 2650 fathoms.

2. *Hexalatractus fusiformis*, n. sp. (Pl. 68, fig. 13).

Shell rough, nearly spindle-shaped, with sharp collar and slight lumbar stricture. Length of the three joints = 2 : 5 : 12, breadth = 3 : 8 : 7. Cephalis hemispherical, with a conical horn of the same length. Thorax hemispherical, with regular, circular, hexagonally-framed pores. Abdomen inversely conical, with irregular, roundish pores. From the upper half of the abdomen arise, with broad triangular base, six divergent wings, which are nearly straight, and slightly fenestrated at the base; their conical distal ends do not reach the horizontal plane, in which the basal apex of the abdomen lies.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·12; breadth, *a* 0·03, *b* 0·08, *c* 0·07.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Genus 610. *Theophæna*,[1] Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Theophænida (vel Tricyrtida multiradiata clausa) with nine lateral wings on the abdomen.

The genus *Theophæna* differs from the preceding six-radiate *Hexalatractus* in the possession of nine lateral wings, and may be derived from the triradiate *Rhopalocanium* by interpolation of six secondary wings between the three primary apophyses.

1. *Theophæna corona*, n. sp. (Pl. 70, fig. 12).

Shell rough, nearly spindle-shaped, with two sharp strictures. Length of the three joints = 4 : 9 : 16, breadth = 5 : 12 : 10. Cephalis hemispherical, very thick-walled, with a conical horn of

[1] *Theophæna* = Divine shell; θεός, φαῖνα.

the same length; both covered with numerous small dimples and spinules. Thorax campanulate; abdomen inversely conical; both with regular, circular pores. Thorax with nine thin curved ribs, which in the upper half of the abdomen arise as nine large feet, which are strongly compressed and curved (with the convexity outwards); their distal ends form nine ovate spinulate cones, and lie in the same horizontal plane as the basal apex of the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·09, *c* 0·16; breadth, *a* 0·05, *b* 0·12, *c* 0·1.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

2. *Theophœna nonaria*, n. sp.

Shell thorny, ovate, with two slight strictures. Length of the three joints = 1 : 4 : 5, breadth = 1 : 5 : 4. Cephalis subspherical, with a conical horn of half the length. Thorax subspherical, with regular, circular pores and conical spines. Abdomen ovate, smooth, with irregular, roundish pores. In the upper half of the thorax descend nine straight, little divergent ribs, which in the lower half become free, and represent nine slender, conical wings; their distal ends do not reach the horizontal plane in which the basal end of the abdomen lies.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·12, *c* 0·15; breadth, *a* 0·03, *b* 0·14, *c* 0·12.

*Habitat.*—South of Australia, Station 160, surface.

## Family LXVII. Theocyrtida, n. fam.

*Theocorida et Theocapsida*, Haeckel, 1881, Prodromus, pp. 434, 436.

*Definition.*—Tricyrtida eradiata. Cyrtoidea with a three-jointed shell, divided by two transverse constrictions into cephalis, thorax, and abdomen, without radial apophyses.

The family Theocyrtida, composed of the Theocorida and Theocapsida of my Prodromus, comprises those Cyrtoidea in which the lattice-shell is three-jointed, and bears no external radial apophyses. The two subfamilies differ in the shape of the terminal mouth, which in the Theocorida is a simple wide opening, in the Theocapsida closed by a lattice-plate. The phylogenetic origin of the Theocyrtida may be found either in the Podocyrtida or in the Sethocyrtida; they may have been derived from the former by reduction and loss of the three primary apophyses, or from the latter by development of an abdomen.

The number of species in this group is very large, and many belong to the most common and widely distributed Cyrtoidea. A great number of living and fossil species have already been described by Ehrenberg, the majority being disposed in his genera *Lithocampe* and *Eucyrtidium*.

The number of genera, however, is comparatively small, and their distinction difficult, since the form of the shell presents no striking differences.

It exhibits all possible passages, from a flatly expanded or nearly discoidal form with a wide open mouth, to a conical or cylindrical, and by constriction of the terminal mouth to an ovate or spindle-shaped form. By complete closure of the mouth the Theocapsida arise. In some genera remarkable traces of the original triradial structure are preserved. The most interesting of these forms is *Axocorys*, with an internal axial columella, which bears a number of verticils, each with three radial branches.

*Synopsis of the Genera of Theocyrtida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Theocorida. Terminal mouth of the abdomen a simple wide opening. | Abdomen gradually dilated towards the wide open mouth. | Abdomen flatly expanded, discoidal. | With horn, | 611. *Theocalyptra.* |
| | | | No horn, | 612. *Cecryphalium.* |
| | | Abdomen conical. | One horn, | 613. *Theoconus.* |
| | | | Two or more horns, | 614. *Lophoconus.* |
| | Abdomen cylindrical, of nearly equal breadth throughout its whole length. Mouth truncate. | A single apical horn on the cephalis. | Thorax and abdomen of equal breadth, | 615. *Theocyrtis.* |
| | | | Thorax much broader than the tubular abdomen, | 616. *Theosyringium.* |
| | | Two horns or a bunch of horns on the cephalis, | | 617. *Lophocyrtis.* |
| | | No horn on the cephalis, | | 618. *Tricolocampe.* |
| | Abdomen ovate or inversely conical. Mouth more or less constricted. | A single apical horn on the cephalis. | Shell-cavity without an internal columella, | 619. *Theocorys.* |
| | | | Shell-cavity with an axial columella, | 620. *Axocorys.* |
| | | Two horns or a bunch of horns on the cephalis, | | 621. *Lophocorys.* |
| | | No horn on the cephalis, | | 622. *Theocampe.* |
| II. Subfamily Theocapsida. Terminal mouth closed by a lattice-plate. | No latticed septum between thorax and abdomen. | | An apical horn, | 623. *Theocapsa.* |
| | | | No horn on the cephalis, | 624. *Tricolocapsa.* |
| | A complete latticed septum between thorax and abdomen, | | | 625. *Phrenocodon.* |

## Subfamily 1. THEOCORIDA, Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theocyrtida with the basal mouth of the shell open (vel Tricyrtida eradiata aperta).

Genus 611. *Theocalyptra*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with discoidal or flatly expanded abdomen. Cephalis with a single apical horn, or with two divergent horns.

The genus *Theocalyptra*, and the following closely allied genus *Cecryphalium*, differ from all the other Theocorida in the flattened form of the cap-shaped or nearly discoidal shell. The abdomen specially is quite flat, often horizontally expanded, and like the marginal brim of a flat hat. They may be derived from the Dicyrtida *Sethocephalus* by the development of an abdomen, or from *Corocalyptra* by loss of the collar wings. The network is usually very delicate, as in the latter. The cephalis of *Theocalyptra* bears one or two horns.

1. *Theocalyptra veneris*, n. sp.

Shell flatly campanulate, very delicate and fragile, very similar to *Eucephryphalus agnesæ* (Pl. 59, fig. 3), but without collar spines. Length of the three joints = 1 : 4 : 2, breadth = 1 : 7 : 9. Cephalis hemispherical, with a single bristle-shaped horn of twice the length. Thorax subconical, separated from the flatter abdomen by a deep stricture, with thin bars, and large, subregular, hexagonal meshes, increasing in size towards the smooth mouth-edge.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·04; breadth, *a* 0·025, *b* 0·15, *c* 0·1.

*Habitat.*—Cosmopolitan; Atlantic, Indian Pacific, many stations, surface.

2. *Theocalyptra orci*, Haeckel.

*Halicalyptra orci*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. x. figs. 9, 10.

Shell flatly campanulate, very similar to the preceding species in general form and fenestration, but flatter and smaller, with different proportions. Length of the three joints = 7 : 2 : 1, breadth = 1 : 6 : 8. Cephalis hemispherical, very small, with two divergent, bristle-shaped horns of the same length. Abdomen nearly horizontally expanded.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·04, *c* 0·01; breadth, *a* 0·02, *b* 0·12, *c* 0·16.

*Habitat.*—Indian Ocean, Zanzibar, depth 2200 fathoms (Pullen).

3. *Theocalyptra discoides*, Haeckel.

*Cycladophora discoides*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 68, Taf. xviii. fig. 4.

Shell flatly campanulate, similar to the two preceding species, but not so delicate, with thicker bars, and roundish, not hexagonal meshes. Length of the three joints = 1 : 2 : 2, breadth = 3 : 6 : 9.

[1] *Theocalyptra* = Divine veil; θεός, καλύπτρα.

Cephalis large, trilobed, with a short, oblique horn of half the length. Thorax campanulate, conical, separated from the abdomen by a circle of smaller pores and a deep stricture. Abdomen flat, discoidal, with three circles of larger pores.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·04; breadth, *a* 0·06, *b* 0·12, *c* 0·18.

*Habitat.*—Fossil in Barbados.

### 4. *Theocalyptra cornuta*, Haeckel.

*Carpocanium cornutum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 287, Taf. ii. fig. 9.

*Halicalyptra cornuta*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. p. 5, pl. i. figs. 13, 14.

*Lophophæna cornuta*, Haeckel, 1862, Monogr. d. Radiol., p. 299.

Shell campanulate-conical, with two sharp strictures. Length of the three joints = 1 : 3 : 1, breadth = 1 : 4 : 5. Cephalis subspherical, with two stout, pyramidal, divergent horns of twice the length. Thorax campanulate, with eight to ten transverse rows of roundish or nearly square pores, increasing in size towards the abdomen, which is flatly expanded, nearly discoidal, separated by a circle of smaller pores; the last circle of pores (on the margin) is larger.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·09, *c* 0·03; breadth, *a* 0·03, *b* 0·12, *c* 0·16.

*Habitat.*—Arctic Ocean, Kamtschatka (Bailey), Greenland (Ehrenberg).

## Genus 612. *Cecryphalium*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with discoidal or flatly expanded abdomen. Cephalis without horn.

The genus *Cecryphalium* has the same flat, conical, or nearly discoidal shell as the preceding *Theocalyptra*, its ancestral genus, but differs from it in the complete absence of horns on the cephalis.

### 1. *Cecryphalium lamprodiscus*, n. sp. (Pl. 58, fig. 2).

Shell flatly conical, with two slight strictures. Length of the three joints = 1 : 3 : 2, breadth = 1 : 7 : 11. Cephalis roundish, very small. Thorax conical, with straight lateral outline; its pores irregular, polygonal, increasing in size towards the girdle. Abdomen little flatter than the thorax, forming its direct prolongation, with five to six circular, concentric rows of pores; the first row formed by sixty to eighty very large, oblongish, quadrangular pores, the second row by very small, the third again by larger pores; the outmost rows by very small and numerous pores.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·04; breadth, *a* 0·02, *b* 0·14, *c* 0·22.

*Habitat.*—Central Pacific, Station 272, surface.

[1] *Cecryphalium* = Net-cap; κεκρυφάλιον.

2. *Cecryphalium sestrodiscus*, n. sp. (Pl. 58, fig. 1).

Shell very flat, subconical, nearly discoidal, with two distinct strictures. Length of the three joints = 1 : 2 : 1, breadth = 1 : 8 : 10. Cephalis kidney-shaped, very small. Thorax flat, campanulate, with curved lateral outline; its pores irregular, polygonal, increasing in size towards the girdle. Abdomen horizontally expanded, like the brim of a hat, with five to six concentric, circular rows of pores, the pores of the inner rows twice to three times as large as those of the outer rows. (The inner circle of large, oblongish, quadrangular pores, characteristic of the preceding species, is here divided into three concentric rings by two circular hoops.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·02; breadth, *a* 0·02, *b* 0·15, *c* 0·2.

*Habitat.*—Central Pacific, Station 274, surface.

## Genus 613. *Theoconus*,[1] n. gen.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with conical abdomen, gradually dilated towards the wide open mouth. Cephalis with a single horn.

The genus *Theoconus*, and the following closely allied *Lophoconus*, differ from the other Theocorida in the conical or campanulate form of the shell; the abdomen is a truncated cone, gradually dilated towards the terminal mouth. The latter is usually truncated, widely open, sometimes with a slightly constricted peristome. The cephalis of *Theoconus* bears a single apical horn.

### Subgenus 1. *Theocorax*, Haeckel.

*Definition.*—Pores of the thorax and of the abdomen of nearly equal size and similar form.

1. *Theoconus zancleus*, Haeckel.

*Eucyrtidium zancleum*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 41, Taf. vi. figs. 1–3.

*Eucyrtidium zancleum*, Haeckel, 1862, Monogr. d. Radiol., p. 321.

Shell bell-shaped, nearly conical, smooth. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 6. Cephalis nearly spherical, with a stout, straight, pyramidal horn of the same length. Thorax hemispherical. Abdomen gradually increasing in breadth towards the wide truncated mouth. Pores in all three joints nearly of the same shape, circular, regular, four times as broad as the thin bars.

*Dimensions.*—Length of the three joints. *a* 0·027, *b* 0·08, *c* 0·1; breadth, *a* 0·03, *b* 0·12, *c* 0·18.

*Habitat.*—Mediterranean (Messina, Naples, Nice, &c.).

[1] *Theoconus* = Divine cone; θεῖος, κῶνος.

2. *Theoconus ægæus*, Haeckel.

*Eucyrtidium ægæum*, Ehrenberg, 1858, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 31; Mikrogeol., 1854, Taf. xxxv. *a*, xix. *a*, fig. 5.
*Eucyrtidium ægæum*, Haeckel, 1862, Monogr. d. Radiol., p. 329.

Shell flatly bell-shaped, nearly conical. Length of the three joints = 2 : 5 : 3; breadth = 1 : 7 : 8. Cephalis ovate, with a stout, straight, pyramidal horn of the same length. Thorax flat, bell-shaped. Abdomen with increasing breadth towards the wide truncated mouth. Pores in all three joints nearly of the same shape, regular, circular, three times as broad as the bars.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·03; breadth, *a* 0·016, *b* 0·07, *c* 0·08.

*Habitat.*—Mediterranean (Coast of Greece and Sicily), surface.

3. *Theoconus zanguebaricus*, Haeckel.

*Eucyrtidium zanguebaricum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. ix. fig. 22.

Shell bell-shaped. Length of the three joints = 1 : 2 : 1, breadth = 1 : 3 : 4. Cephalis ovate, with a straight, pyramidal horn of half the length. Thorax hemispherical, without collar stricture, but with evident girdle stricture. Abdomen dilated towards the wide truncated mouth. Pores regular, hexagonal, of nearly equal size and form, four to six times as broad as the thin bars.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·03; breadth, *a* 0·024, *b* 0·09, *c* 0·11.

*Habitat.*—Indian Ocean (off Zanzibar), Pullen, depth 2200 fathoms.

4. *Theoconus campanulatus*, Haeckel.

? *Eucyrtidium campanulatum*, Ehrenberg, 1858, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 241.
*Eucyrtidium campanulatum*, Haeckel, 1862, Monogr. d. Radiol., p. 329.

Shell bell-shaped, smooth. Length of the three joints = 2 : 3 : 7, breadth = 3 : 7 : 10. Cephalis small, spherical, with a short, conical, oblique horn of the same length. Thorax hemispherical, with an external girdle stricture, prolonged into the truncated, barrel-shaped abdomen, which is a little constricted at the very wide mouth. Pores small and very numerous, regular, circular, twice to three times as broad as the bars.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·07; breadth, *a* 0·03, *b* 0·07, *c* 0·1.

*Habitat.*—North Atlantic, Station 352, surface.

5. *Theoconus orthoconus*, n. sp.

Shell perfectly conical, smooth. Length of the three joints = 1 : 2 : 3, breadth = 1 : 2 : 4. Cephalis hemispherical, with a strong, straight, conical horn of the same length. Thorax conical, without external girdle stricture, prolonged into the truncated, conical abdomen, which is gradually

dilated into a very wide mouth. Pores small, of nearly equal size and similar form, of the same breadth as the bars.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·09; breadth, *a* 0·03, *b* 0·06, *c* 0·12.

*Habitat.*—Cosmopolitan; Atlantic, Pacific; many stations, at different depths.

## Subgenus 2. *Theocorbis*, Haeckel.

*Definition.*—Pores of the thorax and of the abdomen of different sizes or dissimilar forms.

### 6. *Theoconus jovis*, n. sp. (Pl. 69, fig. 4).

Shell bell-shaped, nearly conical. Length of the three joints = 5 : 6 : 7, breadth = 4 : 10 : 14. Cephalis nearly cylindrical, large, little curved, with a very large, oblique, pyramidal horn, as long as the two first joints together. Thorax and the broader abdomen irregularly bell-shaped, dilated towards the wide mouth. Pores circular, somewhat irregularly disposed, gradually increasing in size towards the mouth.

*Dimensions.*—Length of the three joints, *a* 0·05, *b* 0·06, *c* 0·07; breadth, *a* 0·04, *b* 0·1, *c* 0·14.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 7. *Theoconus junonis*, n. sp. (Pl. 69, fig. 7).

Shell nearly conical. Length of the three joints = 4 : 5 : 8, breadth = 3 : 8 : 11. Cephalis ovate, with a large apical opening at the base of the vertical compressed horn, which has about the same length. Thorax and the broader abdomen together conical, gradually dilated towards the wide mouth. Thorax with a bosom-like protuberance on one side. Pores circular, gradually increasing in size.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·05, *c* 0·08; breadth, *a* 0·03, *b* 0·08, *c* 0·11.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 8. *Theoconus longicornis*, n. sp.

Shell conical, thorny. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 6. Cephalis nearly spherical, with a very large, cylindrical, perpendicular, straight horn, once and a half to twice as long as the whole shell. Thorax conical. Abdomen nearly hemispherical, with wide open mouth. Pores circular, four to six times as broad in the thick-walled spiny abdomen as in the thin-walled rough thorax.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·12; breadth, *a* 0·03, *b* 0·09, *c* 0·18.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms; also fossil in Barbados.

9. *Theoconus ampullaceus*, Haeckel.

*Lithocampe ampullacea*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. iv. fig. I.

*Theocorys ampullacea*, Haeckel, 1881, Prodromus, p. 434.

Shell bell-shaped, nearly conical, thorny. Length of the three joints = 3 : 4 : 10; breadth = 4 : 8 : 15. Cephalis subspherical, with a stout lateral horn of the same length. Thorax hemispherical, rough. Abdomen subspherical, widely truncated at both poles, spiny. Pores regular, circular, three to four times as broad in the thick-walled abdomen as in the thin-walled thorax. (Differs from the similar preceding species in the smaller horn and the two deeper strictures of the shell.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·04, *c* 0·1; breadth, *a* 0·04, *b* 0·08, *c* 0·15.

*Habitat.*—Fossil in Barbados.

10. *Theoconus amplus*, Haeckel.

? *Podocyrtis ampla*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 80, Taf. xvi. fig. 7.

? *Podocyrtis ampla*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 539, Taf. xxxiii. fig. 16.

? *Eucyrtidium amplum*, Ehrenberg, 1873, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 248.

Shell conical, smooth, with two broad internal annular septa. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 5. Cephalis subspherical, with a very large, straight, conical horn of the same breadth, which is as long as the conical thorax. Pores regular, circular, twice as broad in the truncate, gradually dilated abdomen as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·12; breadth, *a* 0·03, *b* 0·12, *c* 0·15.

*Habitat.*—Fossil in Barbados.

11. *Theoconus ariadnes*, n. sp.

Shell conical, nearly bell-shaped, smooth. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 5. Cephalis subspherical, with a conical spine of about the same length. Thorax hemispherical, thin-walled. Abdomen conical, slightly constricted at the wide open mouth. Pores regular, circular, twice as large in the thick-walled abdomen as in the thin-walled thorax.

*Dimensions.*—Length of the three joints, *a* 0·018 to 0·022, *b* 0·03 to 0·035, *c* 0·06 to 0·07; breadth, *a* 0·015 to 0·02, *b* 0·04 to 0·06, *c* 0·07 to 0·09.

*Habitat.*—Cosmopolitan; Atlantic, Indian, and Pacific Oceans, common, surface.

12. *Theoconus dionysius*, Haeckel.

*Thyrsocyrtis dionysia*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 5.

*Thyrsocyrtis jacchia*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 7.

Shell bell-shaped, smooth. Length of the three joints = 1 : 3 : 5, breadth = 1 : 4 : 5. Cephalis subspherical, with a conical, irregularly denticulate horn of twice or thrice the length. Thorax

inflated, nearly spherical, truncate at both poles, separated by a deep stricture from the cephalis, as well as from the conical abdomen, which is dilated gradually towards the wide mouth. Pores in the thorax subregular, circular, in the abdomen twice to four times larger, and irregular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·1; breadth, *a* 0·02, *b* 0·08, *c* 0·1.

*Habitat.*—Fossil in Barbados.

13. *Theoconus laterna*, n. sp.

Shell conical, smooth. Length of the three joints = 1 : 2 : 4, breadth = 1 : 2 : 4. Cephalis small, ovate, with a strong, pyramidal, vertical horn three times the length. Thorax hemispherical, with subregular, circular, hexagonally-framed pores. Abdomen truncate, conical, with only fifteen to twenty very large, irregular, polygonal pores, which are separated by very thick bars of the same breadth as the horn.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·12; breadth, *a* 0·03, *b* 0·07, *c* 0·12.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

14. *Theoconus ficus*, Haeckel.

*Eucyrtidium ficus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 19.

*Theocorys ficus*, Haeckel, 1881, Prodromus, p. 434.

Shell conical, pear-shaped, smooth. Length of the three joints = 1 : 5 : 20, breadth = 2 : 10 : 25. Cephalis very small, ovate, with a conical, straight horn three times the length. Thorax quite conical, with solid wall, without pores. Abdomen very large, nearly spherical, truncate at both poles, little constricted at the very wide mouth; its pores subregular, circular, about three times as broad as the bars. (This species is intermediate between the genera *Theoconus* and *Theocorys*.)

*Dimensions.*—Length of the three joints, *a* 0·01, *b* 0·05, *c* 0·2; breadth, *a* 0·02, *b* 0·1, *c* 0·25.

*Habitat.*—Fossil in Barbados.

## Genus 614. *Lophoconus*,[1] n. gen.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with conical abdomen gradually dilated towards the wide open mouth. Cephalis with two or more horns or a corona of horns.

The genus *Lophoconus* has the same conical shell with truncate mouth as *Theoconus*, and differs from it only in the armature of the cephalis, bearing either two large divergent horns (usually a larger occipital and a smaller frontal horn), or a bunch or corona of numerous divergent horns.

[1] *Lophoconus* = Cone with a crest; λόφος, κῶνος.

1. *Lophoconus antilope*, Haeckel.

*Eucyrtidium antilope*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. ix. fig. 18.

Shell conical, smooth, with two slight strictures. Length of the three joints = 1 : 3 : 8, breadth = 2 : 4 : 8. Cephalis hemispherical, with two divergent, pyramidal horns of twice the length. Thorax campanulate. Abdomen gradually dilated towards the wide open mouth. Pores very small and numerous, regular, hexagonal.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·05, *c* 0·12; breadth, *a* 0·025, *b* 0·07, *c* 0·12.

*Habitat.*—Indian Ocean; between Aden and Socotra (Haeckel); Zanzibar (Pullen).

2. *Lophoconus hexagonalis*, n. sp.

Shell campanulate, conical, spiny, with two sharp strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 6. Cephalis hemispherical, with numerous conical spines of different sizes, the largest of twice the length. Thorax campanulate, with smaller spines. Abdomen inflated, dilated towards the wide mouth. Pores large, three or four times as broad as the bars, subregular, hexagonal.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·09; breadth, *a* 0·03, *b* 0·07, *c* 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Lophoconus cornutella*, n. sp.

Shell slender, conical, smooth, without external strictures, but with two internal, annular septa. Length of the three joints = 1 : 2 : 6, breadth = 1 : 2 : 4. Cephalis ovate, with two stout, divergent, conical horns of three times the length. Thorax and abdomen together conical, gradually dilated towards the wide truncate mouth. Pores regular, circular, quincuncial.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·12; breadth, *a* 0·02, *b* 0·04, *c* 0·08.

*Habitat.*—North Atlantic, Station 353, depth 2965 fathoms.

4. *Lophoconus apiculatus*, Haeckel.

*Eucyrtidium apiculatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 10.

Shell campanulate, conical, thorny, with two distinct strictures. Length of the three joints = 1 : 2 : 2, breadth = 1 : 3 : 4. Cephalis subspherical, with a bunch of eight to twelve divergent, conical horns, the largest of which are longer than the cephalis. The regular, circular pores are in the campanulate thorax scarcely half as broad as in the truncate, gradually dilated abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·04; breadth, *a* 0·025, *b* 0·06, *c* 0·08.

*Habitat.*—Fossil in Barbados.

5. *Lophoconus cervus*, Haeckel.

? *Eucyrtidium cervus*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. ix. fig. 21.

Shell conical, smooth, without external stricture, but with two internal annular septa. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 6. Cephalis campanulate, with two to six divergent, partly ramified horns. Pores in the thorax regular, circular, in the abdomen three to four times as large, regular, hexagonal.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08 ; breadth, *a* 0·02, *b* 0·06, *c* 0·12.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface (? Zanzibar, 2200 fathoms, Pullen).

6. *Lophoconus rhinoceros*, n. sp. (Pl. 69, fig. 2).

Shell campanulate, conical, rough, with two sharp strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis subspherical, with numerous very small pores, and two stout, divergent, pyramidal horns, the major of which is longer, the minor shorter, than the cephalis. Thorax campanulate, with small, regular, circular pores. Abdomen inflated, with thickened margin at the wide open mouth, and with irregular, roundish pores, twice to four times as broad as those of the thorax.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·09 ; breadth, *a* 0·04, *b* 0·09, *c* 0·12.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

## Genus 615. *Theocyrtis*,[1] n. gen.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with cylindrical abdomen, and wide open truncate mouth. Cephalis with a single horn.

The genus *Theocyrtis* and the three following closely allied genera differ from the other Theocorida in the cylindrical form of the slender abdomen, which is of equal breadth nearly throughout its whole length. The terminal mouth is wide open, usually truncate, and of the same breadth ; sometimes slightly constricted. The cephalis of Theocyrtis bears a single horn.

### Subgenus 1. *Theocorypha*, Haeckel.

*Definition.*—Pores of the thorax and abdomen of nearly equal size and similar form.

1. *Theocyrtis trachelius*, Haeckel.

*Eucyrtidium trachelius*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 8.

Shell thin-walled and very fragile, smooth. Length of the three joints = 2 : 8 : 7, breadth = 2 : 9 : 8. Cephalis subspherical, with a straight, conical horn of the same length, separated by a

[1] *Theocyrtis* = Divine basket ; θεός, κυρτίς.

slender neck from the inflated, subspherical thorax. Abdomen cylindrical, with a wide open, truncate mouth. Pores subregular, hexagonal, of equal size, four to six times as broad as the thin, thread-like bars.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·07 ; breadth, *a* 0·02, *b* 0·09, *c* 0·08.

*Habitat.*—Tropical Pacific, many Stations (200, 224, 271, &c.), surface, and in various depths.

### 2. *Theocyrtis barbadensis*, Haeckel.

*Eucyrtidium barbadense*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. ix. fig. 7.

Shell thin-walled, smooth. Length of the three joints = 2 : 4 : 5, breadth, 2 : 5 : 4. Cephalis ovate or conical, with a strong, conical horn, without external stricture, dilated into the campanulate thorax. Abdomen cylindrical, with a wide open, truncate mouth. Pores subregular, circular, quincuncially disposed, of about the same breadth as the bars.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·08, *c* 0·1 ; breadth, *a* 0·04, *b* 0·1, *c* 0·08.

*Habitat.*—Fossil in the Tertiary rocks of Barbados.

### 3. *Theocyrtis cylindrica*, Haeckel.

*Eucyrtidium cylindricum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 1.

Shell elongate, cylindrical, straight, smooth. Length of the three joints = 1 : 2 : 6, breadth = 1 : 3 : 3. Cephalis hemispherical, with a thick, pyramidal horn of the same length (the edges of the horn giving to it the appearance of being composed of two converging spines). Thorax truncated, conical. Abdomen perfectly cylindrical, much elongated. Pores subregular, circular, twice as broad as the bars, quincuncially disposed. Mouth wide open, truncate.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·12 ; breadth, *a* 0·03, *b* 0·06, *c* 0·06.

*Habitat.*—Tropical Pacific, Station 266, depth 2750 fathoms ; fossil in Barbados.

### 4. *Theocyrtis elegans*, Haeckel.

*Eucyrtidium elegans*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 12.
? *Eucyrtidium pusillum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 6.

Shell slender, cylindrical, straight, smooth. Length of the three joints = 1 : 2 : 7, breadth = 1 : 3 : 3. Cephalis subconical, with a small conical horn. Thorax campanulate, conical. Abdomen cylindrical, very slender. Pores subregular, circular, small, disposed in transverse rows. three in the thorax, six to eight in the abdomen. Mouth wide open, truncate.

*Dimensions.*—Length of the three joints, *a* 0·01, *b* 0·02, *c* 0·07 ; breadth, *a* 0·015, *b* 0·03, *c* 0·03.

*Habitat.*—Fossil in Barbados and Sicily.

5. *Theocyrtis paupera*, Haeckel.

*Eucyrtidium pauperum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 13.

Shell slender, cylindrical, smooth. Length of the three joints = 1 : 2 : 6, breadth = 1 : 3 : 3. Cephalis hemispherical, with a stout conical horn of twice the length. Thorax truncate, conical. Abdomen cylindrical. Pores very small, regular, circular, disposed in transverse rows, one or two in the thorax, three to five in the abdomen. (Distance between the rows twice as great as in the preceding nearly related species.) Mouth wide open, truncate.

*Dimensions.*—Length of the three joints, *a* 0·01, *b* 0·02, *c* 0·06; breadth, *a* 0·015, *b* 0·03, *c* 0·03.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms; also fossil in Barbados and Sicily.

6. *Theocyrtis microtheca*, Haeckel.

*Eucyrtidium microtheca*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 10.

*Eucyrtidium hillaby*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 8.

Shell cylindrical, a little rough. Length of the three joints = 1 : 3 : 4, breadth = 1 : 3 : 3. Cephalis subspherical, with a small conical horn. Thorax hemispherical or campanulate. Abdomen cylindrical, with wide open truncate mouth. Pores subregular, circular, quincuncially disposed, of medium size, rudimentary or wanting in the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·015 to 0·02, *b* 0·03 to 0·05, *c* 0·05 to 0·08; breadth, *a* 0·02 to 0·025, *b* 0·05 to 0·06, *c* 0·05 to 0·06.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms; also fossil in Barbados.

## Subgenus 2. *Theocorusca*, Haeckel.

*Definition.*—Pores of the thorax and the abdomen of different sizes or forms.

7. *Theocyrtis macroceros*, n. sp. (Pl. 69, fig. 13).

Shell almost cylindrical, smooth. Length of the three joints = 1 : 2 : 5, breadth = 2 : 3 : 4. Cephalis hemispherical, with a very large cylindrical horn, once or twice as long as the shell. Thorax truncate, hemispherical. Abdomen cylindrical, only slightly contracted towards both ends. Two girdle strictures deep. Pores small, subregular, circular, more irregular and twice to three times as large in the abdomen as in the thorax, disposed in transverse rows, five to six in the thorax, eight to ten in the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02 to 0·03, *b* 0·04 to 0·05, *c* 0·1 to 0·12; breadth, *a*, 0·04, *b* 0·07, *c* 0·08.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms; also fossil in Barbados.

8. *Theocyrtis ptychodes*, n. sp. (Pl. 69, fig. 8).

Shell almost cylindrical, smooth. Length of the three joints = 1 : 3 : 3, breadth = 2 : 4 : 4. Cephalis hemispherical, with a large, conical, curved horn of twice the length. Thorax very large, inflated, campanulate, thick-walled. Abdomen cylindrical, with a thin folded wall (like a petticoat), the thickness of which decreases gradually towards the wide truncate mouth. Pores subregular, circular, and quincuncially disposed in the two first joints, irregular and larger in the abdomen, forming longitudinal series between the folds.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·1, *c* 0·11; breadth, *a* 0·05, *b* 0·12, *c* 0·12.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

9. *Theocyrtis aspera*, Haeckel.

*Eucyrtidium asperum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. viii. fig. 15.

Shell almost cylindrical, with rough or thorny surface. Length of the three joints = 1 : 3 : 5, breadth = 1 : 5 : 5. Cephalis subspherical, small, with a short conical horn. Thorax hemispherical, inflated. Abdomen cylindrical, with wide truncate mouth. Pores in the thorax subregular, circular, quincuncially disposed, in the abdomen irregular roundish, two to four times as large.

*Dimensions.*—Length of the three joints, *a* 0·015 to 0·02, *b* 0·06 to 0·07, *c* 0·08 to 0·1; breadth, *a* 0·02, *b* 0·1, *c* 0·1.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms; fossil in Barbados.

10. *Theocyrtis proserpinæ*, n. sp.

Shell almost cylindrical, smooth. Length of the three joints = 3 : 6 : 9, breadth = 2 : 8 : 7. Cephalis subspherical, with a stout conical horn. Thorax campanulate. Abdomen cylindrical. Pores regular, circular, quincuncially disposed, double-edged in the thorax, and three to four times as large as in the cephalis and the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·09; breadth, *a* 0·02, *b* 0·08, *c* 0·07.

*Habitat.*—North Pacific, Stations 244 to 253, depth 2050 to 3125 fathoms.

11. *Theocyrtis oenophila*, Haeckel.

*Thyrsocyrtis oenophila*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 8.

Shell in the apical half conical, in the lower cylindrical. Length of the three joints = 2 : 5 : 6, breadth = 3 : 8 : 7. Cephalis subspherical, with a large prismatic horn, which is bulbous at the base, and armed with three teeth at the distal apex. Thorax conical, constricted at the base, with subregular, circular, quincuncial pores. Abdomen cylindrical, with a coronal of nine large

roundish pores beyond the lumbar stricture, and two to four succeeding transverse rows of irregular, roundish, smaller pores. Mouth widely open, truncated.

*Dimensions.*—Length of the three joints. *a* 0·02, *b* 0·05, *c* 0·06; breadth, *a* 0·03, *b* 0·08, *c* 0·07.

*Habitat.*—Fossil in Barbados.

Genus 616. *Theosyringium*, Haeckel,[1] 1881, Prodromus, p. 434.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with cylindrical abdomen, which is much narrower than the inflated thorax, and forms a slender, narrow tube, with truncated mouth. Cephalis with a single horn.

The genus *Theosyringium* differs from the closely allied *Theocyrtis*, its ancestral form, in the wide inflated thorax, which is much broader than the narrow tubular abdomen. The mouth of the latter is small and truncate.

1. *Theosyringium tibia*, n. sp. (Pl. 68, fig. 4).

Shell rough, very slender, with two distinct strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 2 : 1. Cephalis ovate, with a conical horn of the same length. Thorax ellipsoidal. Abdomen cylindrical, as long as the two former joints together. Pores subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·12; breadth, *a* 0·03, *b* 0·06, *c* 0·02.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

2. *Theosyringium pipetta* n. sp. (Pl. 68, fig. 5).

Shell rough, inflated, with two sharp strictures. Length of the three joints = 2 : 7 : 9, breadth = 2 : 7 : 2. Cephalis conical, with a slender horn of half the length. Thorax subglobose. Abdomen cylindrical, as long as the two former joints together. Pores subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·09; breadth, *a* 0·02, *b* 0·07, *c* 0·02.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Theosyringium siphonium*, n. sp.

Shell rough, inflated, with two deep strictures. Length of the three joints = 1 : 3 : 3, breadth = 1 : 2 : 1. Cephalis subspherical, with a stout pyramidal horn of twice the length. Thorax broad ovate. Abdomen slender, inversely conical, as long as the thorax, and one-third as broad as the base. Pores subregular, circular, hexagonally framed. (Similar to *Eusyringium cenosiphon*, Pl. 78, fig. 10) but only with two strictures and three joints.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·1, *c* 0·1; breadth, *a* 0·03, *b* 0·07, *c* 0·025.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

[1] *Theosyringium* = Divine tube; *θεός*, *συρίγγιον*.

4. *Theosyringium tubulus*, Haeckel.

*Eucyrtidium tubulus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 6.

Shell smooth, slenderly spindle-shaped, with two slight strictures. Length of the three joints = 2 : 10 : 8, breadth = 3 : 6 : 3. Cephalis hemispherical, hyaline, with a stout, pyramidal horn of the same length. Thorax spindle-shaped. Abdomen inversely conical, half as long as the thorax prolonged into a slender, cylindrical tube. Pores subregular, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·1, *c* 0·08; breadth, *a* 0·03, *b* 0·06, *c* 0·03.

*Habitat.*—Fossil in Barbados.

## Genus 617. *Lophocyrtis*,[1] n. gen.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with cylindrical abdomen, and wide open truncate mouth. Cephalis with two horns, or a bunch of horns.

The genus *Lophocyrtis* differs from its ancestral form *Theocyrtis* only in the armature of the cephalis, bearing instead of a single horn either two divergent horns, or a bunch, or coronal of numerous spines. The slender abdomen is in both genera cylindrical, with wide open mouth.

1. *Lophocyrtis holothuria*, n. sp.

Shell smooth, slender, with two distinct strictures. Length of the three joints = 1 : 2 : 4, breadth = 2 : 4 : 3. Cephalis hemispherical, with a bunch of five divergent, conical horns, the middle of which is larger and vertical, nearly as long as the thorax. Thorax campanulate, half as long as the cylindrical abdomen. Mouth truncate. Pores regular, circular, quincuncial. (Similar to *Theocyrtis cylindrica*, but with different cephalis and thorax.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·1; breadth, *a* 0·04, *b* 0·07, *c* 0·06.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

2. *Lophocyrtis stephanophora*, Haeckel.

*Eucyrtidium stephanophorum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. viii. fig. 14.

Shell smooth, slender, with deep collar and indistinct lumbar stricture. Length of the three joints = 1 : 2 : 4, breadth = 1 : 3 : 3. Cephalis subspherical, with very small circular pores, and a corona of three to nine short conical spines. Thorax campanulate, with regular, circular pores, which are half or one-third as broad as those of the cylindrical abdomen.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·09; breadth, *a* 0·025, *b* 0·06, *c* 0·06.

*Habitat.*—Fossil in Barbados.

[1] *Lophocyrtis* = Basket with a crest; λόφος, κυρτίς.

3. *Lophocyrtis synapta*, n. sp.

Shell spiny, with two sharp strictures. Length of the three joints = 5 : 10 : 6, breadth = 4 : 9 : 7. Cephalis large, ovate, with numerous (twenty to thirty or more) conical, radially divergent spines of different sizes, the largest about as long as the cephalis. Thorax subconical, with numerous short, conical, divergent spines, which are directed downwards. Abdomen smooth, cylindrical. The irregular, polygonal pores are separated by thin bars, and in the thorax are twice to four times as broad as in the first and last joints.

*Dimensions.*—Length of the three joints, *a* 0·05, *b* 0·1, *c* 0·06; breadth, *a* 0·04, *b* 0·09, *c* 0·07.

*Habitat.*—Indian Ocean, Maldive Islands (Haeckel), surface.

4. *Lophocyrtis coronata*, Haeckel.

*Eucyrtidium coronatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 9.

Shell smooth, cylindrical, with two deep strictures. Length of the three joints = 4 : 3 : 4, breadth = 4 : 5 : 4. Cephalis subspherical, large, of about the same size and form as the thorax, with a coronal of four to eight short, conical spines on the apex. Pores in the two first joints irregular, roundish, twice to four times as broad as the small, circular pores of the cylindrical abdomen, which are disposed in four to eight transverse rows.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·03, *c* 0·04; breadth, *a* 0·04, *b* 0·05, *c* 0·04.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms; fossil in Barbados.

5. *Lophocyrtis biaurita*, Haeckel.

*Eucyrtidium biauritum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 8.

*Eucyrtidium biauritum*, Bütschli, 1882, Zeitschr. f. wiss. Zool., p. 540, Taf. xxxiii. fig. 38, *a–f*.

Shell smooth, with two distinct strictures. Length of the three joints = 1 : 6 : 3, breadth = 2 : 5 : 4. Cephalis small, hemispherical, hyaline, with two large, divergent, curved horns of three times the length. Thorax ovate, with few small, widely scattered pores. Abdomen cylindrical, without pores.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·06, *c* 0·03; breadth, *a* 0·02, *b* 0·05, *c* 0·04.

*Habitat.*—Fossil in Barbados.

## Genus 618. *Tricolocampe*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta), with cylindrical abdomen, and wide open truncate mouth. Cephalis without horn.

The genus *Tricolocampe* differs from its ancestral genus, *Theocyrtis*, in the loss of the cephalic horn; it has the same cylindrical form of the slender abdomen, and a wide

[1] *Tricolocampe* = Caterpillar with three joints; τρίς, κῶλον, κάμπη.

open terminal mouth of the same breadth. The whole shell is more or less cylindrical, (sometimes conical in the upper part), with two distinct external strictures, or internal annular septa.

## Subgenus 1. *Tricolocampium*, Haeckel.

*Definition.*—Pores of the thorax and of the abdomen of nearly equal size and similar form.

### 1. *Tricolocampe cylindrica*, n. sp. (Pl. 66, fig. 21).

Shell nearly cylindrical, smooth. Length of the three joints = 2 : 3 : 15, breadth = 3 : 4 : 5. Cephalis hemispherical, with numerous very small pores. Thorax and abdomen cylindrical, of about equal breadth, with equal, circular pores, disposed regularly in transverse rows, three to four rows in the thorax, ten to twelve in the abdomen. Mouth wide open, not constricted.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·15; breadth, *a* 0·03, *b* 0·04, *c* 0·05.

*Habitat.*—Central Pacific, Stations 265 to 274, depth 2350 to 2925 fathoms.

### 2. *Tricolocampe pupa*, Haeckel.

*Eucyrtidium pupa*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 16.

Shell nearly cylindrical, smooth. Length of the three joints = 2 : 2 : 8, breadth = 2 : 3 : 3. Cephalis subspherical, with four larger pores. Thorax and abdomen cylindrical, of about equal breadth, with equal, very small pores, disposed regularly in transverse rows, two rows in the thorax, eight to ten in the abdomen. Mouth wide open, a little constricted.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·02, *c* 0·08; breadth, *a* 0·02, *b* 0·03, *c* 0·03.

*Habitat.*—Tropical Pacific (Philippine Sea), Station 206, depth 2100 fathoms.

### 3. *Tricolocampe polyzona*, n. sp. (Pl. 66, fig. 19).

Shell nearly cylindrical, thick-walled. Length of the three joints = 4 : 4 : 12, breadth = 8 : 9 : 9. Cephalis obtuse, conical. Thorax barrel-shaped. Abdomen in the middle part a little constricted. Pores very numerous, subregular, disposed regularly in transverse rows, six to eight in the cephalis, eight to ten in the thorax, twelve to fifteen in the abdomen. Mouth rather constricted, only half as broad as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·04, *c* 0·12; breadth, *a* 0·08, *b* 0·09, *c* 0·09.

*Habitat.*—Central Pacific, Stations 266 to 272, depth 2425 to 2925 fathoms; also fossil in the Nicobars and in Barbados.

4. *Tricolocampe stenozona*, n. sp. (Pl. 66, fig. 20).

Shell nearly cylindrical, thin-walled. Length of the three joints = 5 : 4 : 9, breadth = 6 : 8 : 9. Form of the three joints and disposition of their pores nearly equal to the preceding species; but the proportion of the joints is different, the shell more delicate, and the mouth more widely open, and nearly as broad as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·05, *b* 0·04, *c* 0·09; breadth, *a* 0·06, *b* 0·08, *c* 0·09.

*Habitat.*—North Pacific, Station 256, depth 2950 fathoms.

5. *Tricolocampe amphizona*, n. sp. (Pl. 66, fig. 17).

Shell mitre-shaped, very thick-walled. Length of the three joints = 2 : 1 : 1, breadth nearly uniform. Cephalis obtuse, conical, as long as the two other cylindrical joints together (probably composed of several united joints). Pores subregular, disposed in transverse rows, six to eight in the cephalis, two in the thorax, and two in the abdomen. Mouth widely open.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·02, *c* 0·02; breadth, *a* 0·04, *b* 0·05, *c* 0·05.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

6. *Tricolocampe panthera*, Haeckel.

*Eucyrtidium panthera*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 18.

Shell mitre-shaped or nearly cylindrical, thick-walled. Length of the three joints = 1 : 2 : 3, breadth = 1 : 2 : 2. Cephalis subspherical. Thorax campanulate. Abdomen cylindrical. Pores in all three joints irregular, roundish, of different sizes, irregularly disposed. Mouth widely open, truncated, not constricted.

*Dimensions.*—Length of the three joints, *a* 0·015 to 0·02, *b* 0·04 to 0·05, *c* 0·06 to 0·08; breadth about *a* 0·02, *b* and *c* 0·05.

*Habitat.*—Cosmopolitan; Atlantic, Pacific; also fossil in Barbados.

## Subgenus 2. *Tricolocamptra*, Haeckel.

*Definition.*—Pores of the thorax and the abdomen of different sizes or forms.

7. *Tricolocampe urnula*, n. sp. (Pl. 66, fig. 22).

Shell cylindrical, with obtuse conical apex, smooth. Length of the three joints = 2 : 3 : 10, breadth = 2 : 3 : 6. Cephalis subspherical. Thorax barrel-shaped. Abdomen cylindrical with slightly constricted wide mouth. Pores irregular, roundish, three to four times as broad in the abdomen as in the thorax, irregularly disposed.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·1; breadth, *a* 0·025, *b* 0·035, *c* 0·06.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

8. *Tricolocampe doliolum*, n. sp.

Shell cylindrical, with hemispherical apex, rough. Length of the three joints = 1 : 3 : 5, breadth = 1 : 2 : 3. Cephalis spherical. Thorax and abdomen cylindrical, of nearly equal breadth. Mouth widely open, not constricted. Pores irregular, roundish, in the abdomen three to four times as large as in the thorax, disposed in oblique rows.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·16; breadth, *a* 0·03, *b* 0·05, *c* 0·09.

*Habitat.*—Fossil in Barbados.

9. *Tricolocampe cingulata*, n. sp.

Shell subcylindrical, with obtuse conical apex, thick-walled. Length of the three joints = 2 : 3 : 11, breadth = 3 : 7 : 8. Cephalis hemispherical, not separated externally from the short conical thorax, but with internal collar septum. Abdomen cylindrical, with wide open, non-constricted mouth. Pores in the thorax narrow, obliquely ascending, in the abdomen twice as large, circular, arranged in ten to twelve regular transverse rows, separated by slight strictures. Lumbar septum nearly complete.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·1 to 0·12; breadth, *a* 0·03, *b* 0·07, *c* 0·08.

*Habitat.*—Fossil in Barbados, and in Tertiary rocks of Sicily; living in the depths of the Atlantic and Central Pacific, Station 348, depth 2450 fathoms; Station 268, depth 2900 fathoms.

10. *Tricolocampe arcta*, Haeckel.

? *Eucyrtidium arctum*, Ehrenberg, 1858, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 33.
? *Lithocampe arcta*, Haeckel, 1862, Monogr. d. Radiol., p. 317.

Shell subcylindrical, with obtuse conical apex. Length of the three joints = 1 : 2 : 4, breadth = 1 : 2 : 2. Cephalis subspherical. Thorax campanulate, separated by a deep collar, but a slight lumbar stricture. Abdomen cylindrical, with wide truncate mouth. Pores in the thorax narrow, obliquely ascending, in the abdomen half as large, very small, and densely disposed in six to eight regular transverse rows.

*Dimensions.*—Length of the three joints, *a* 0·022, *b* 0·045, *c* 0·09; breadth, *a* 0·026, *b* 0·05, *c* 0·05.

*Habitat.*—Central Pacific, Station 266 to 274, depth 2350 to 2925 fathoms.

## Genus 619. *Theocorys*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with ovate abdomen, broader than the constricted mouth. Cephalis with a single horn.

The genus *Theocorys* and the two following closely allied genera, united formerly with *Eucyrtidium*, differ from the preceding Theocorida in the constriction of the

[1] *Theocorys*=Divine helmet; θεός, κόρυς.

peristome, so that the inflated abdomen is broader than the terminal mouth. They represent, therefore, the transition to the Theocapsida, with closed mouth. The abdomen is commonly more or less ovate or barrel-shaped, sometimes inversely conical. The cephalis of *Theocorys* bears a single apical horn,

## Subgenus 1. *Theocoronium*, Haeckel.

*Definition.*—Pores of the thorax and of the abdomen of nearly equal size and similar form.

### 1. *Theocorys turgidula*, Haeckel.

*Eucyrtidium turgidulum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 13.

Shell slender, ovate, with two deep strictures, very fragile and thin-walled. Length of the three joints = 2 : 5 : 7, breadth = 2 : 6 : 6. Cephalis subspherical, with a pyramidal horn of the same length. Thorax nearly spherical. Abdomen ovate, twice as broad as the constricted mouth. Pores very numerous, regular hexagonal, three to four times as broad as the bars.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·005, *c* 0·07; breadth, *a* 0·02, *b* 0·06, *c* 0·06.

*Habitat.*—Tropical Pacific (Philippine Sea), Stations 206 and 224, surface.

### 2. *Theocorys veneris*, n. sp. (Pl. 69, fig. 5).

Shell inversely ovate, with two deep strictures, smooth. Length of the three joints = 2 : 5 : 6, breadth = 3 : 7 : 6. Cephalis hemispherical, with a slender conical horn of twice the length. Thorax nearly spherical. Abdomen ovate, twice as broad as the constricted mouth. Pores regular, circular, twice as broad as the bars, quincuncially disposed.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·06; breadth, *a* 0·03, *b* 0·07, *c* 0·06.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific; many Stations, surface.

### 3. *Theocorys cretica*, Haeckel.

*Eucyrtidium creticum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. xi. fig. 23.

Shell ovate, thin-walled, smooth, with two deep strictures. Length of the three joints = 2 : 4 : 4, breadth = 3 : 6 : 6. Cephalis hemispherical, with a conical horn of the same length. Thorax and abdomen nearly hemispherical, inflated, united by the opposite bases of the hemispheres. Constricted mouth only one-third as broad as the abdomen. Pores very small and numerous, regular, circular, of the same breadth as the bars, quincuncially disposed.

*Dimensions.*—Length of the three joints, *a* 0·2, *b* 0·04, *c* 0·04; breadth, *a* 0·03, *b* 0·06, *c* 0·06.

*Habitat.*—Mediterranean, Crete, Corfu, surface.

4. *Theocorys ovata*, n. sp. (Pl. 69, fig. 16).

Shell quite ovate, thick-walled, smooth, without external strictures. Length of the three joints = 2 : 2 : 9, breadth = 3 : 5 : 7. Cephalis conical, with a thick conical horn of the same length. Thorax and abdomen gradually dilated towards the base, and then hemispherical, constricted. Mouth scarcely one-third as broad as the abdomen, prolonged into a short tube. Pores regular, circular, disposed in transverse rows, two to three in the cephalis, two to three in the thorax, eight to ten in the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·02, *c* 0·09; breadth, *a* 0·03, *b* 0·05, *c* 0·07.

*Habitat.*—Central Pacific, Stations 263 to 268, depth 2650 to 3000 fathoms.

5. *Theocorys plutonis*, n. sp. (Pl. 69, fig. 1).

Shell ovate, thick-walled, smooth, with two slight strictures. Length of the three joints = 2 : 5 : 4, breadth = 4 : 7 : 6. Cephalis hemispherical, with a conical, oblique horn of the same length. Thorax and abdomen only slightly inflated, gradually decreasing towards the wide, little constricted mouth. Pores subregular, circular, much larger in the abdomen and the lower half of the thorax than in the upper half and the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·04; breadth, *a* 0·04, *b* 0·07, *c* 0·06.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

6. *Theocorys scolopax*, Haeckel.

*Eucyrtidium scolopax*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. ix. fig. 5.

Shell slender, inversely ovate, smooth. Length of the three joints = 1 : 3 : 3, breadth = 1 : 4 : 4. Cephalis subspherical, with a long, slightly curved horn, half as long as the whole shell. Thorax campanulate. Abdomen inversely ovate, twice as broad as the constricted mouth (incomplete in Ehrenberg's figure).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·06; breadth, *a* 0·02, *b* 0·08, *c* 0·08.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Theocorythium*, Haeckel.

*Definition.*—Pores of the thorax and of the abdomen of different sizes or dissimilar forms.

7. *Theocorys dianæ*, n. sp. (Pl. 69, fig. 11).

Shell almost ovate, with two deep strictures. Length of the three joints = 3 : 6 : 8, breadth = 3 : 9 : 8. Cephalis subspherical, with a slender, pyramidal horn of three times the length. Thorax

conical, constricted at the base. Abdomen bottle-shaped. Pores in the thorax irregular, polygonal, in the abdomen subregular, circular, quincuncially disposed.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·08; breadth, *a* 0·03, *b* 0·09, *c* 0·08.

*Habitat.*—North Pacific, Station 253, surface.

### 8. *Theocorys hyalothorax*, n. sp.

Shell slender, ovate, with two deep strictures. Length of the three joints = 6 : 9 : 8, breadth = 7 : 12 : 11. Cephalis subspherical, with numerous densely-placed circular pores, and with a pyramidal, slender horn of the same length. Thorax hemispherical, hyaline, without any pores. Abdomen ovate, twice as broad as the constricted mouth, with two to four widely distant, transverse rows of small, circular pores.

*Dimensions.*—Length of the three joints, *a* 0·024, *b* 0·036, *c* 0·032; breadth, *a* 0·028, *b* 0·048, *c* 0·044.

*Habitat.*—Tropical Pacific, Station 225, depth 4475 fathoms.

### 9. *Theocorys bachabunda*, Haeckel.

*Thyrsocyrtis bachabunda*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84 Taf. xii. fig. 4.

Shell inversely ovate, with two distinct strictures. Length of the three joints = 2 : 5 : 9, breadth = 3 : 9 : 8. Cephalis subspherical, small, with a large cylindrical horn, which is half as long as the whole shell, and armed with spines at the conical apex. Thorax conical, inflated, with small, subregular, circular, quincuncial pores. Abdomen inversely ovate, with irregular, roundish, pores of larger and smaller sizes mixed, gradually lessening towards the constricted mouth.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·09; breadth, *a* 0·03, *b* 0·09, *c* 0·08.

*Habitat.*—Fossil in Barbados.

### 10. *Theocorys attenuata*, Haeckel.

*Eucyrtidium attenuatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 16.

Shell inversely ovate, with distinct collar, but indistinct lumbar stricture. Length of the three joints = 2 : 5 : 5, breadth = 2 : 7 : 6. Cephalis hemispherical, with a short, oblique, conical horn. Thorax inflated, campanulate, with small, regular, circular, quincuncial pores. Abdomen inversely conical, with irregular pores of larger and smaller sizes mixed, gradually lessening towards the truncated mouth.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·05; *a* 0·025, *b* 0·07, *c* 0·06.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

### 11. *Theocorys obliqua*, n. sp. (Pl. 69, fig. 10).

Shell inversely ovate, with distinct collar, but indistinct lumbar stricture. Length of the three joints = 3 : 7 : 4, breadth = 4 : 9 : 8. Cephalis hemispherical, with a stout, pyramidal, oblique

horn of the same length. Thorax and abdomen together ovate, gradually lessening towards the constricted mouth, which is only half as broad. Pores irregular, roundish, in the thorax twice to four times as broad as in the abdomen. Both joints are separated by an oblique, internal, lumbar septum, which in some specimens observed was more oblique than in that figured; some specimens had a very irregular form.

*Dimensions.*—Length of the three joints, *a* 0·025 to 0·03, *b* 0·06 to 0·07, *c* 0·03 to 0·04; breadth, *a* 0·04, *b* 0·09, *c* 0·08.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms; also fossil in Barbados.

### 12. *Theocorys alaudæ*, Haeckel.

*Eucyrtidium alauda*, Ehrenberg, 1875, Adhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. ix. fig. 4.

Shell nearly spindle-shaped, decreasing from the thicker middle towards both ends. Length of the three joints = 1 : 3 : 8, breadth = 1 : 4 : 5. Cephalis subspherical, with a strong, conical horn of three times the length. Thorax campanulate, with numerous regular, circular, quincuncial pores. Abdomen inversely ovate, slender, twice as broad as the truncated mouth, with irregular, roundish pores, three to four times as large as those of the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·16; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Fossil in Barbados and in Tertiary rocks of Sicily.

### 13. *Theocorys apollinis*, n. sp. (Pl. 69, figs. 3).

Shell ovate, with two deep strictures. Length of the three joints = 2 : 3 : 5, breadth = 2 : 5 : 7. Cephalis subspherical, with a large, straight, cylindrical horn, about as long as the whole shell (in the specimen figured this is broken off). Thorax truncate, conical. Abdomen subglobose, truncate on both poles, twice as broad as the constricted mouth. Pores quincuncial, subregular, circular, twice as broad in the abdomen as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·05; breadth, *a* 0·02, *b* 0·05, *c* 0·07.

*Habitat.*—South Atlantic, Station 332, surface.

### 14. *Theocorys sphærophila*, Haeckel.

*Eucyrtidium sphærophilum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. viii. fig. 16.

Shell almost ovate, rough, with two slight strictures. Length of the three joints = 2 : 7 : 10, breadth = 3 : 8 : 12. Cephalis subspherical, with a strong, conical horn of the same length. Thorax nearly spherical, with subregular, circular pores of different sizes. Abdomen ovate, truncate at both poles, nearly twice as broad as the constricted mouth, with very large, subregular, hexagonal pores, four to six times as broad as the bars, in three to four transverse, and ten to twelve longitudinal rows.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·1; breadth, *a* 0·03, *b* 0·08, *c* 0·12.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms; fossil in Barbados.

15. *Theocorys tuberculata*, n. sp.

Shell almost ovate, tuberculate, with deep collar, but slight lumbar stricture. Length of the three joints = 2 : 5 : 12, breadth = 3 : 8 : 11. Cephalis hemispherical, with a cylindrical horn of twice the length. Thorax hemispherical, with regular, circular, double-edged, quincuncial pores, between which conical tubercles occur. Abdomen truncate, ovate, twice as broad as the constricted mouth, with regular, circular, hexagonally-framed pores, three to four times as broad as those of the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·12; breadth, 0·03, *b* 0·08, *c* 0·11.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms; fossil in Barbados.

16. *Theocorys martis*, n. sp.

Shell slender, ovate, with two deep strictures. Length of the three joints = 3 : 6 : 18, breadth = 4 : 8 : 12. Cephalis small, hemispherical, with a very large, sword-shaped broad horn, nearly as long as the whole shell. Thorax hemispherical, honey-comb like, with regular, circular, hexagonally-framed pores. Abdomen ovate, with irregular, roundish, very large pores, four to six times as broad as the bars, and as the pores of the thorax. Constricted mouth half as broad as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·18; breadth, *a* 0·04, *b* 0·08, *c* 0·12.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

17. *Theocorys mercurii*, n. sp.

Shell ovate, conical, with two slight strictures. Length of the three joints = 1 : 3 : 7, breadth = 2 : 4 : 7. Cephalis hemispherical, with a broad pyramidal horn of the same length. Thorax campanulate, with longitudinal series of small, regular, circular pores, separated by divergent crests. Abdomen nearly spherical, one and a half times as broad as the constricted mouth, which is prolonged into a thin, solid, cylindrical peristome. Pores of the abdomen regular, circular, hexagonally framed, three to four times as broad as the bars, and as the pores of the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·15; breadth, *a* 0·04, *b* 0·09, *c* 0·15.

*Habitat.*—South Atlantic, Station 338, depth 1990 fathoms.

18. *Theocorys minervæ*, n. sp. (Pl. 69, fig. 14).

Shell ovate, conical, with two deep strictures. Length of the three joints = 1 : 3 : 4, breadth = 1 : 4 : 5. Cephalis subspherical, with a large pyramidal horn as long as the thorax, and with small, circular pores. Thorax rough, with regular, quincuncial, circular pores, three to four times as large as those of the cephalis. Abdomen barrel-shaped, with irregular, roundish pores of very different sizes, six very large pores immediately beyond the lumbar stricture, and four to five rows

of pores, which are twice to four times as large as those of the thorax. Mouth truncated, with thickened margin, two-thirds as broad as the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·12, *c* 0·16; breadth, *a* 0·04, *b* 0·16, *c* 0·2.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Genus 620. *Axocorys*,[1] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta), with ovate abdomen, including an internal vertical axial rod, which bears three divergent radial spines or verticils of three branches, and is prolonged into an apical horn.

The genus *Axocorys* contains only a single but very remarkable species, and may, perhaps, represent a peculiar group, which has closer relations to the Plectoidea than to the other Tricyrtida. The pyriform three-jointed shell has neither lateral nor terminal free appendages, but possesses a very large apical horn, and an inner prolongation of this, an axial rod, which bears some triradiate verticils of branched spines. The original ancestral forms of this remarkable genus are probably *Plagoniscus* and *Plectaniscus* (pp. 912 and 924).

### 1. *Axocorys macroceros*, n. sp. (Pl. 68, figs. 1, 1*a*).

Shell pear-shaped, with two distinct strictures. Length of the three joints = 2 : 3 : 16, breadth = 3 : 6 : 16. Cephalis hemispherical, with few small pores. From its apex arises vertically a very long three-sided prismatic horn with denticulate edges, three to four times as long as the shell. An inner thin prolongation of the horn descends vertically nearly to the mouth, and bears on its basal end three verticils of branched spines, each verticil with three divergent forked spines (fig. 1*a*). Pores regular, circular, in the subspherical abdomen three times as large as in the hemispherical thorax. The constricted mouth is scarcely broader than the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·16; breadth *a* 0·03, *b* 0·06, *c* 0·16.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 621. *Lophocorys*,[2] Haeckel, 1881, Prodromus, p. 434.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta), with ovate abdomen, broader than the constricted mouth. Cephalis with two divergent horns, or with a bunch of horns.

[1] *Axocorys* = Helmet with an internal axis; ἄξις, κόρυς.

[2] *Lophocorys* = Helmet with a top crest; λόφος, κόρυς.

The genus *Lophocorys* differs from its ancestral form, *Theocorys*, only in the armature of the cephalis, bearing either two divergent horns, or a corona of several radial horns. In two species there are four horns on the apex, a larger vertical (occipital) horn being surrounded by three smaller, upwards divergent horns.

1. *Lophocorys astrocephala*, n. sp. (Pl. 69, fig. 9).

Shell smooth, inversely ovate, with deep collar and slight lumbar stricture. Length of the three joints = 3 : 7 : 6, breadth = 4 : 11 : 10. Cephalis subspherical, stellate, densely covered with numerous (ten to twenty or more) divergent, large, slenderly conical horns, the longest of which reach the length of the shell. Thorax campanulate, with small, regular, circular pores. Abdomen tapering towards the constricted mouth, in the upper half with the same pores, in the lower half with smaller, scarce pores, or nearly hyaline.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·07, *c* 0·06; breadth, *a* 0·04, *b* 0·11, *c* 0·1.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Lophocorys acanthocephala*, Haeckel.

*Eucyrtidium acanthocephalum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. ix. fig. 8.

Shell rough, bottle-shaped, with two slight strictures. Length of the three joints = 5 : 11 : 7, breadth = 4 : 12 : 10. Cephalis conical, with a large pyramidal horn of the same length, and three smaller divergent accessory horns at the base of the three edges of the latter. Thorax campanulate, nearly as long as the tapering abdomen (which in the figure of Ehrenberg is broken off). Pores regular, circular, quincuncial.

*Dimensions.*—Length of the three joints, *a* 0·05, *b* 0·11, *c* 0·07; breadth, *a* 0·04, *b* 0·12, *c* 0·1.

*Habitat.*—Fossil in Barbados.

3. *Lophocorys bicornis*, Haeckel.

*Eucyrtidium bicorne*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 7.

Shell smooth, almost spindle-shaped, with two slight strictures. Length of the three joints = 2 : 8 : 3, breadth = 3 : 5 : 4. Cephalis hemispherical, with two stout, pyramidal, divergent horns of twice the length. Thorax ovate, with seven to eleven transverse rows of small, regular, circular pores (often very scarce in the upper half). Abdomen with two to four transverse rows of the same pores. Mouth constricted, half as broad as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·03; breadth, *a* 0·03, *b* 0·05, *c* 0·04.

*Habitat.*—Fossil in Barbados.

4. *Lophocorys quadricornis*, n. sp.

Shell rough, slenderly ovate, with two distinct strictures. Length of the three joints = 2 : 4 : 2, breadth = 2 : 4 : 3. Cephalis ovate, with four very stout, three-sided prismatic horns; the largest is as long as the thorax and vertical upon the apex, the three smaller are as long as the cephalis and diverge upwards from the base of the former. Thorax ovate, with large, irregular, roundish pores, which are three to four times as broad as the small, circular pores of the first and the third joint. Constricted mouth half as broad as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·045, *b* 0·085, *c* 0·04; breadth, *a* 0·035, *b* 0·075, *c* 0·06.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

5. *Lophocorys bovicornis*, n. sp. (Pl. 69, fig. 12).

Shell rough, subovate, with two deep strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 3 : 4. Cephalis subspherical, with two divergent, curved horns of different lengths. Thorax campanulate, with small, circular pores. Abdomen subspherical, truncate at both poles, twice as broad as the constricted mouth, thorny, with very large, circular pores, four to six times as broad as those of the smaller thorax.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·09; breadth, *a* 0·04, *b* 0·09, *c* 0·12.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

## Genus 622. *Theocampe*,[1] n. gen.

*Definition.*—Theocorida (vel Tricyrtida eradiata aperta) with ovate abdomen, broader than the constricted mouth. Cephalis without horn.

The genus *Theocampe* differs from the two preceding genera in the absence of horns on the cephalis, and may, therefore be derived from *Theocorys* by reduction of the apical horn. It bears to the latter the same relation as *Tricolocampe* does to *Theocyrtis*.

### Subgenus 1. *Theocampana*, Haeckel.

*Definition.*—Pores of the thorax and the abdomen of nearly equal size and similar form.

1. *Theocampe ehrenbergii*, Haeckel.

*Dictyomitra ehrenbergii*, Zittel, 1876, Zeitschr. d. deutsch. geol. Gesellsch., p. 82, Taf. ii. fig. 5.

Shell ovate, smooth. Length of the three joints = 2 : 3 : 13, breadth = 4 : 7 : 12. Cephalis hemispherical. Thorax truncate, conical. Abdomen inflated, nearly spherical, twice as broad as the constricted mouth. Pores of nearly equal size and form, small, regular, circular.

[1] *Theocampe* = Divine caterpillar; *θεός*, *κάμπη*.

*Dimensions.*—Length of the three joints, *a* 0·014, *b* 0·018, *c* 0·076; breadth, *a* 0·023, *b* 0·044, *c* 0·073.

*Habitat.*—Fossil in the chalk of Northern Germany; Brunswick (Zittel).

2. *Theocampe pirum*, Haeckel.

*Eucyrtidium pirum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. x. fig. 14.
*Eucyrtidium excellens*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 540, Taf. xxxiii. fig. 31.

Shell ovate, smooth. Length of the three joints = 3 : 5 : 15, breadth = 6 : 10 : 16. Cephalis hemispherical. Thorax truncate conical. Abdomen inflated, subspherical, three times as broad as the constricted mouth. Pores of nearly equal size, regular, circular, in the thorax alternating, in the abdomen disposed in five to six transverse, widely distant rows.

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·025, *c* 0·075; breadth, *a* 0·03, *b* 0·05, *c* 0·08.

*Habitat.*—Fossil in the Tertiary rocks of Barbados.

3. *Theocampe stenostoma*, n. sp. (Pl. 66, fig. 23).

Shell about ovate, smooth. Length of the three joints = 3 : 4 : 3, breadth = 6 : 8 : 9. Cephalis hemispherical, large. Thorax and abdomen short, barrel-shaped. Both strictures deep. Abdomen three times as broad as the constricted mouth. Pores of equal size, regular, circular, disposed in oblique rows.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·04, *c* 0·03; breadth, *a* 0·06, *b* 0·08, *c* 0·09.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

4. *Theocampe nucula*, Haeckel.

*Eucyrtidium nucula*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 29, Taf. vii. fig. 19.

Shell nearly ovate, rough. Length of the three joints = 3 : 5 : 3, breadth = 4 : 7 : 6. Cephalis hemispherical, large. Thorax and abdomen inflated. Both strictures deep. Thorax broader than the short abdomen, and twice as broad as the constricted mouth. Pores of equal size, regular, circular, regularly disposed in transverse rows: three in the cephalis, six in the thorax, and three in the abdomen.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·03; breadth, *a* 0·04, *b* 0·07, *c* 0·06.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms; also fossil in Barbados.

5. *Theocampe cryptoprora*, Haeckel.

*Eucyrtidium cryptoprora*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. vii. fig. 14.

Shell ovate, thin-walled, smooth, without external strictures, but with two distinct internal annular septa. Length of the three joints = 2 : 7 : 4, breadth = 3 : 7 : 6. Cephalis, large, subspherical,

hyaline; its lower half hidden in the upper part of the campanulate thorax. Mouth little constricted, nearly as broad as the truncate abdomen. All pores equal, small, regular, circular.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·07, *c* 0·04; breadth, *a* 0·03, *b* 0·07, *c* 0·06.

*Habitat.*—Tropical Pacific, Stations 225 to 265, in various depths.

### 6. *Theocampe ovulum*, n. sp.

Shell perfectly ovate, thick-walled, smooth, without external strictures, but with two broad, internal septa. Length of the three joints = 2 : 3 : 10, breadth = 3 : 6 : 8. Cephalis and thorax together obtuse, conical, with obliquely ascending pores. Abdomen inflated, twice as broad as the constricted mouth, with ten to twelve transverse rows of pores. All pores equal, small, regular, circular.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·1; breadth, *a* 0·03, *b* 0·06, *c* 0·08.

*Habitat.*—Fossil in Tertiary rocks of Barbados and Sicily.

### 7. *Theocampe cassis*, Haeckel.

*Eucyrtidium cassis*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. vii. fig. 20.

Shell bottle-shaped, thin-walled, with slight collar, but deep lumbar stricture. Length of the three joints = 3 : 8 : 6, breadth = 2 : 7 : 7. Cephalis ovate. Thorax campanulate. Abdomen inflated, twice as broad as the constricted mouth. Pores equal, regular, circular, disposed in quincuncial rows.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·06; breadth, *a* 0·02, *b* 0·07, *c* 0·07.

*Habitat.*—Tropical Pacific (Philippines), Station 206, depth 2100 fathoms.

## Subgenus 2. *Theocamptra*, Haeckel.

*Definition.*—Pores of the thorax and the abdomen of different sizes or dissimilar forms.

### 8. *Theocampe sphærothorax*, n. sp. (Pl. 66, fig. 25).

Shell almost ovate, rough. Length of the three joints = 2 : 5 : 10, breadth = 3 : 8 : 8. Cephalis hemispherical. Thorax nearly spherical, truncate. Abdomen ovate, twice as broad as the constricted mouth. Pores subregular, circular, quincuncially disposed, in the abdomen twice as broad as in the thorax, and four times as broad as in the cephalis.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·1; breadth, *a* 0·03, *b* 0·08, *c* 0·08.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

9. *Theocampe versipellis*, Haeckel.

*Eucyrtidium versipellis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 14.

Shell slenderly ovate, rough. Length of the three joints = 3 : 5 : 13, breadth = 4 : 8 : 9. Cephalis subspherical, without pores. Thorax hemispherical. Abdomen inflated, twice as broad as the constricted mouth. Pores subregular, circular, quincuncially disposed, in the abdomen three times as broad as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·025, *b* 0·05, *c* 0·13; breadth, 0·04, *b* 0·08, *c* 0·09.

*Habitat.*—Fossil in Barbados.

10. *Theocampe megalopora*, Haeckel.

*Eucyrtidium megaloporum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. vii. fig. 19.

Shell almost ovate, with two distinct strictures. Length of the three joints = 2 : 6 : 3, breadth = 3 : 6 : 4. Cephalis hemispherical. Thorax ovate, inflated. Abdomen inversely ovate, two to three times as broad as the constricted mouth. Pores subregular, circular, quincuncially disposed, twice as broad in the large thorax as in the smaller abdomen.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·03; breadth, *a* 0·03, *b* 0·06, *c* 0·04.

*Habitat.*—Central Pacific, Station 267, depth 2700 fathoms.

11. *Theocampe collaris*, n. sp. (Pl. 66, fig. 18).

Shell almost ovate, with two distinct strictures. Length of the three joints = 3 : 3 : 6, breadth = 4 : 5 : 7. Cephalis obtuse conical, with five or six transverse rows of small pores. Thorax truncate conical, with longitudinal furrows, each of which contains a single pore. Abdomen inflated, with five or six distant, transverse rows of small, circular pores.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·03, *c* 0·06; breadth, *a* 0·04, *b* 0·05, *c* 0·07.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

12. *Theocampe gemmata*, Haeckel.

*Eucyrtidium gemmatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 6.

Shell slenderly ovate, smooth, with two internal annular septa. Length of the three joints = 1 : 1 : 4, breadth = 1 : 2 : 3. Cephalis campanulate, nearly as large as the truncate, conical thorax, both with small, irregular, obliquely descending pores. Abdomen broader, twice as broad as the constricted mouth, with numerous longitudinal ribs, alternating with single rows of small, circular pores. (This and the following allied species approach to *Cycladophora*, by the abdominal ribs.)

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·02, *c* 0·07; breadth, *a* 0·025, *b* 0·035, *c* 0·045.

*Habitat.*—Fossil in Barbados.

13. *Theocampe costata*, n. sp. (Pl. 66, fig. 24).

Shell almost ovate, with two sharp strictures. Length of the three joints = 2 : 4 : 8, breadth = 3 : 5 : 7. Cephalis hemispherical. Thorax twice as large, also hemispherical, both with regular, circular, quincuncial pores. Abdomen broader, with numerous longitudinal ribs, alternating with longitudinal rows of larger pores. Mouth constricted, half as broad as the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·08; breadth, *a* 0·03, *b* 0·05, *c* 0·07.

*Habitat.*—Indian Ocean, Sunda Straits (Rabbe), surface.

14. *Theocampe cryptocephala*, Haeckel.

*Eucyrtidium cryptocephalum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 11.

Shell ovate, rough, with two distinct strictures. Length of the three joints = 1 : 2 : 4, breadth = 1 : 4 : 5. Cephalis subspherical, its lower half hidden in the campanulate thorax. Abdomen subspherical, twice as broad as the constricted mouth. Pores subregular, circular, quincuncial, twice as broad in the abdomen as in the thorax.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·07; breadth, *a* 0·025, *b* 0·07, *c* 0·09.

*Habitat.*—Fossil in Barbados.

Subfamily 2. THEOCAPSIDA, Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Theocyrtida with the basal mouth of the shell fenestrated (vel Tricyrtida eradiata clausa).

Genus 623. *Theocapsa*,[1] Haeckel, 1881, Prodromus, p. 436.

*Definition.*—Theocapsida (vel Tricyrtida eradiata clausa), with an apical horn, and a terminal lattice-plate on the mouth.

The genus *Theocapsa*, and the two following genera, represent together the small subfamily of Theocapsida, or of those Tricyrtida in which the mouth is closed by a lattice-plate, and external radial appendages are wanting. *Theocapsa* may be derived from *Theocorys* by fenestration of the constricted mouth.

Subgenus 1. *Theocapsetta*, Haeckel.

*Definition.*—Thorax of about the same size as the abdomen, or somewhat larger; pores of both nearly equal in size and similar in form.

[1] *Theocapsa* = Divine capsule; θεός, κάψα.

1. *Theocapsa aristotelis*, n. sp. (Pl. 66, fig. 6).

Shell subovate, smooth, with two distinct strictures. Length of the three joints = 2 : 6 : 7, breadth = 3 : 8 : 8. Cephalis hemispherical, with a conical, slender horn of about the same length. Thorax and abdomen nearly equal in size, thin-walled, smooth, with small, regular, circular pores of equal size. Basal pole rounded.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·07; breadth, *a* 0·03, *b* 0·08, *c* 0·08.

*Habitat.*—Mediterranean (Gibraltar), Atlantic (Canary Islands), surface.

2. *Theocapsa plinii*, n. sp.

Shell subovate, smooth, with two indistinct strictures. Length of the three joints = 2 : 5 : 6, breadth = 3 : 7 : 7. Cephalis hemispherical, with a pyramidal, thick horn of about the same length. Thorax and abdomen of nearly equal size, thick-walled, rough, with large, regular, circular, double-edged pores of equal size (twice as large and half as numerous as in the similar preceding species).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·06; breadth, *a* 0·03, *b* 0·07, *c* 0·07.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

3. *Theocapsa democriti*, n. sp. (Pl. 66, fig. 8).

Shell slender, ovate, spiny, with two distinct strictures. Length of the three joints = 3 : 5 : 6, breadth = 4 : 7 : 7. Cephalis ovate, with numerous slender horns of the same length. Thorax and abdomen with small, irregular, roundish pores of nearly equal size, armed with scattered slender spines, half as long as the cephalic horns. Basal pole hemispherical, rounded.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·06; breadth, *a* 0·04, *b* 0·07, *c* 0·07.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Theocapsa galeni*, n. sp.

Shell broadly ovate, spiny, with two deep strictures. Length of the three joints = 2 : 7 : 6, breadth = 3 : 8 : 7. Cephalis hemispherical, with two conical, divergent horns of the same length. Thorax and abdomen with large, irregular, roundish pores of nearly equal size, armed with numerous short spines, not larger than the pores. Basal pole conical, pointed.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·07, *c* 0·06; breadth, *a* 0·03, *b* 0·08, *c* 0·07.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

## Subgenus 2. *Theocapsilla*, Haeckel.

*Definition.*—Thorax of about the same size as the abdomen, or somewhat larger; pores of the two different in size or form.

5. *Theocapsa wottonis*, n. sp. (Pl. 66, fig. 11).

Shell subovate, rough, with two deep strictures. Length of the three joints = 3 : 7 : 5, breadth = 3 : 9 : 8. Cephalis subspherical, with regular, circular, hexagonally-framed pores, and with a stout pyramidal horn of the same length. Thorax conical, with subregular, circular, double-edged pores. Abdomen hemispherical, smaller and thinner walled, with irregular, somewhat oblong pores. Basal pole rounded.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·07, *c* 0·05; breadth, *a* 0·03, *b* 0·09, *c* 0·08.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

6. *Theocapsa gessneri*, n. sp.

Shell broadly ovate, with two deep strictures. Length of the three joints = 3 : 9 : 5, breadth = 4 : 10 : 4. Cephalis hemispherical, with a slender, conical horn of the same length. Thorax subspherical, with small, regular, circular pores. Abdomen inversely conical, with few large, somewhat oblong pores. Basal pole acute.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·09, *c* 0·05; breadth, *a* 0·04, *b* 0·1, *c* 0·04.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

7. *Theocapsa aldrovandi*, n. sp.

Shell slender, inversely ovate, with two slight strictures. Length of the three joints = 3 : 8 : 14, breadth = 4 : 11 : 8. Cephalis subglobular, with a conical horn of the same length. Thorax also subglobular, papillate, with regular, circular, hexagonally-framed pores. Abdomen inversely conical, slender, with very small and numerous, subregular, circular pores. Basal pole ovate, pointed.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·14; breadth, *a* 0·04, *b* 0·11, *c* 0·08.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

8. *Theocapsa malpighii*, n. sp. (Pl. 66, fig. 15).

Shell inversely ovate, with two distinct strictures. Length of the three joints = 3 : 8 : 11, breadth = 4 : 9 : 8. Cephalis hemispherical, with a conical horn of the same length. Thorax hemispherical, thorny, with very small circular pores, surrounded by large, regular, hexagonal frames. Abdomen inversely campanulate, with larger circular pores, and longitudinal ribs. Basal pole blunt, conical.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·08, *c* 0·11; breadth, *a* 0·04, *b* 0·09, *c* 0·08.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Subgenus 3. *Theocapsomma*, Haeckel.

*Definition.*—Thorax much smaller than the abdomen, pores of the two nearly equal in size and similar in form.

9. *Theocapsa linnæi*, n. sp. (Pl. 66, fig. 13).

Shell slender, subcylindrical, rough, with two slight strictures. Length of the three joints = 1 : 3 : 6, breadth = 1 : 4 : 4. Cephalis hemispherical, with a pyramidal horn of twice the length (sometimes, as in the specimen figured, one or two small accessory horns occur at its base). Thorax hemispherical, thick-walled. Abdomen nearly cylindrical, twice as long as the thorax, thin-walled, with a hemispherical, rounded basal pole. The specimen figured is an abnormal one, with some deformities on the irregular abdomen; in numerous other specimens the abdomen is cylindrical, regular. Pores of the thorax and abdomen equal, very small and numerous, regular, circular, three to four times as broad as the bars.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05 to 0·06, *c* 0·1 to 0·12; breadth, *a* 0·03, *b* 0·06 to 0·07, *c* 0·07 to 0·08.

*Habitat.*—Cosmopolitan; Atlantic, Indian, and Pacific Oceans; many Stations at various depths.

10. *Theocapsa forskalii*, n. sp. (Pl. 66, fig. 9).

Shell slender, subcylindrical, smooth, with two slight strictures. Length of the three joints = 1 : 1 : 3, breadth = 1 : 2 : 2. Cephalis hemispherical, with a conical horn of half the length. Abdomen three times as long as the thorax, of the same breadth, with the same irregular, roundish pores, large and small intermingled. Basal pole rounded.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·09; breadth, *a* 0·03, *b* 0·06, *c* 0·06.

*Habitat.*—North Atlantic, Canary Islands, Station 353, depth 2965 fathoms.

11. *Theocapsa wolffii*, n. sp. (Pl. 66, fig. 14).

Shell slender, spindle-shaped, very thick-walled, rough, without external strictures, but with two broad internal girdles. Length of the three joints = 2 : 3 : 15, breadth = 4 : 5 : 7. Cephalis with a short horn of the same length, conical. Abdomen five times as long as the thorax, with the same subregular, circular pores. Basal pole inversely conical, with some larger, elongate pores.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·15; breadth, *a* 0·04, *b* 0·05, *c* 0·07.

*Habitat.*—Mediterranean, Crete, depth 1620 fathoms (Spratt).

12. *Theocapsa pallasii*, n. sp.

Shell subovate, thorny, with two slight strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 2 : 3. Cephalis ovate, with a pyramidal horn of the same length. Thorax and abdomen with subregular, circular pores of medium size. Basal pole hemispherical. (Differs from *Theocapsa mülleri*, Pl. 66, fig. 7, mainly in the larger number and smaller size of the regular, quincuncial pores.)

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·06, *c* 0·09; breadth, *a* 0·03, *b* 0·06, *c* 0·09.

*Habitat.*—Tropical Atlantic, Station 342, depth 1445 fathoms.

## Subgenus 4. *Theocapsura*, Haeckel.

*Definition.*—Thorax much smaller than the abdomen, pores of the two different in size or form.

### 13. *Theocapsa lamarckii*, n. sp. (Pl. 66, fig. 16).

Shell slenderly ovate, rough, with two distinct strictures. Length of the three joints = 1 : 2 : 7, breadth = 1 : 4 : 5. Cephalis subspherical, with a conical horn of twice the length. Thorax conical, with regular, circular pores. Abdomen three times longer, with subregular, hexagonal pores of twice the size. Basal pole hemispherical, with very large, irregular, roundish pores.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·14; breadth, *a* 0·03, *b* 0·08, *c* 0·1.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

### 14. *Theocapsa cuvieri*, n. sp. (Pl. 66, fig. 10).

Shell slenderly spindle-shaped, thorny, with two slight strictures. Length of the three joints = 1 : 3 : 6, breadth = 1 : 3 : 3. Cephalis subspherical, with a conical horn of the same length. Thorax conical, spiny, with regular, circular, double-edged pores. Abdomen thinner-walled, inversely conical, with irregular, roundish pores. Basal pole acute, with a bunch of larger spines.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·12; breadth, *a* 0·02, *b* 0·05, *c* 0·06.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 15. *Theocapsa baerii*, n. sp.

Shell slenderly spindle-shaped, smooth, with two indistinct strictures. Length of the three joints = 1 : 2 : 8, breadth = 2 : 3 : 4. Cephalis hemispherical, with a thick, conical horn of the same length. Abdomen four times as long as the thorax. Pores in the thorax small and numerous, regular, circular, in the abdomen twice as large, and irregularly roundish. Basal pole inversely conical, acute. (Differs from *Theocapsa wolffii*, Pl. 66, fig. 14, mainly in the shape of the pores.)

*Dimensions.*—Length of the three joints, *a* 0·015, *b* 0·03, *c* 0·12; breadth, *a* 0·03, *b* 0·04, *c* 0·06.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

### 16. *Theocapsa rathkei*, n. sp.

Shell slenderly conical, with two slight strictures. Length of the three joints = 1 : 2 : 10, breadth = 2 : 4 : 15. Cephalis small, with a large, conical horn of three times the length. Thorax small, thorny, with small, irregular, roundish pores. Abdomen very large, as long and as broad as the thorax, with irregular, polygonal or roundish, very large pores, the margin of which is finely denticulate. Basal pole truncate, rounded.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·05, *c* 0·2; breadth, *a* 0·04, *b* 0·08, *c* 0·3.

*Habitat.*—Fossil in Barbados.

17. *Theocapsa schwannii*, n. sp.

Shell slenderly ovate, or pear-shaped, with two distinct strictures. Length of the three joints = 1 : 2 : 7, breadth = 2 : 4 : 7. Cephalis subspherical, small, with a stout, pyramidal horn of three times the length. Cavity of the thorax subspherical, its thick wall with small, regular, circular, hexagonally-framed pores. Abdomen very thick-walled, with crested bars, and very large, irregular, roundish pores. Basal pole rounded, truncate.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·14; breadth, *a* 0·04, *b* 0·08, *c* 0·14.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

18. *Theocapsa müller*i, n. sp. (Pl. 66, fig. 7).

Shell slenderly ovate, or pear-shaped, spiny, with two indistinct strictures. Length of the three joints = 1 : 2 : 3, breadth = 1 : 2 : 3. Cephalis ovate, with a stout, pyramidal horn of the same length, and with a variable number of smaller accessory horns. Pores irregular, roundish, three to four times as broad in the inflated abdomen as in the thorax. Basal pole hemispherical, spiny.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·09; breadth, *a* 0·03, *b* 0·07, *c* 0·09.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

19. *Theocapsa sarsii*, n. sp.

Shell pear-shaped, with two indistinct strictures. Length of the three joints = 1 : 1 : 3, breadth = 1 : 2 : 4. Cephalis with a thick horn of the same length, conical. Abdomen subspherical, very thick-walled, its pores regular, circular, twice as broad as the bars, and three times as broad as those of the thorax. Basal pole flat, rounded.

*Dimensions.*—Length of the three joints, *a* 0·04, *b* 0·05, *c* 0·12; breadth, *a* 0·05, *b* 0·11, *c* 0·15.

*Habitat.*—Fossil in Barbados.

20. *Theocapsa darwinii*, n. sp. (Pl. 66, fig. 12).

Shell pear-shaped, with two distinct strictures. Length of three joints = 1 : 1 : 5, breadth = 1 : 2 : 5. Cephalis hemispherical, with a conical horn of twice the length. Thorax campanulate, with small, regular, circular pores. Abdomen broad, ovate, with larger, regular, circular, hexagonally-framed pores. Basal pole hemispherical.

*Dimensions*—Length of the three joints, *a* 0·03, *b* 0·04, *c* 0·2; breadth, *a* 0·04, *b* 0·08, *c* 0·2.

*Habitat.*—Central Pacific, Stations 263 to 274, depth 2350 to 2925 fathoms.

## Genus 624. *Tricolocapsa*,[1] Haeckel.

*Definition.*—Theocapsida (vel Tricyrtida eradiata clausa) without apical horn, with a terminal lattice-plate on the mouth.

[1] *Tricolocapsa* = Three-jointed capsule; τρικῶλον, κάψα.

The genus *Tricolocapsa* differs from the preceding *Theocapsa* in the loss of the apical horn, and exhibits therefore to it the same relation that *Theocampe* bears to *Theocorys*. In some species (Pl. 66, figs. 1, 3) a small tube begins to be developed on the cephalis, and these may perhaps be separated as a peculiar genus, *Tricolopera*.

### Subgenus 1. *Tricolocapsula*, Haeckel.

*Definition.*—Thorax of about the same size as the abdomen, or larger.

#### 1. *Tricolocapsa theophrasti*, n. sp. (Pl. 66, fig. 1).

Shell slenderly ovate, with two slight strictures. Length of the three joints = 2 : 8 : 5, breadth = 3 : 7 : 5. Cephalis hemispherical, with a larger, tube-like, cervical pore at the collar stricture. Thorax very thick-walled, with irregular, roundish, double-edged pores, smaller than the bars between them. Abdomen smaller, inversely campanulate-conical, with very irregular pores. Basal pole acute.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·05; breadth, *a* 0·03, *b* 0·07, *c* 0·05.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

#### 2. *Tricolocapsa dioscoridis*, n. sp. (Pl. 66, fig. 3).

Shell short and broad, with two deep strictures. Length of the three joints = 3 : 5 : 4, breadth = 4 : 7 : 5. Cephalis hemispherical, with a larger, tube-like, cervical pore above the collar stricture. Thorax very broad, with irregular, large and spare, roundish pores. Abdomen much smaller, inversely conical, with smaller pores. Basal pole obtuse.

*Dimensions.*—Length of the three joints, *a* 0·03, *b* 0·05, *c* 0·04; breadth, *a* 0·04, *b* 0·07, *c* 0·05.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

#### 3. *Tricolocapsa linnæi*, n. sp. (Pl. 66, fig. 5).

Shell short and broad, with two deep strictures. Length of the three joints = 1 : 4 : 2, breadth = 1 : 4 : 2. Cephalis hemispherical. Thorax thick-walled, inflated, with subregular, circular, double-edged pores. Abdomen much smaller, thin-walled, with irregular, polygonal pores. Basal pole hemispherical, rounded.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·08, *c* 0·05; breadth, *a* 0·03, *b* 0·08, *c* 0·05.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

4. *Tricolocapsa decandollei*, n. sp. (Pl. 66, fig. 4).

Shell subovate, with two sharp strictures. Length of the three joints = 2 : 2 : 2, breadth = 3 : 4 : 3·5. Cephalis campanulate. Thorax broader, ring-shaped. Abdomen inversely hemispherical. All three joints of the same length, thick-walled, with the same regular and peculiar reticulation, the small circular pores being surrounded by square, elevated frames.

*Dimensions.*—Length of the three joints, *a* 0·07, *b* 0·07, *c* 0·07; breadth, *a* 0·10, *b* 0·14, *c* 0·12.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Subgenus 2. *Tricolocapsium*, Haeckel.

*Definition.*—Thorax much smaller than the abdomen.

5. *Tricolocapsa brownii*, n. sp.

Shell ovate, very thick-walled, with two indistinct strictures. Length of the three joints = 2 : 4 : 7, breadth = 3 : 7 : 10. Cephalis flat, hemispherical. Thorax truncate, conical. Abdomen inflated, inversely hemispherical. Pores regular, circular, of the same breadth as the bars, hexagonally-framed, twice as large in the abdomen as in the thorax. Basal pole rounded.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·04, *c* 0·07; breadth, *a* 0·03, *b* 0·07, *c* 0·1.

*Habitat.*—Fossil in Barbados.

6. *Tricolocapsa schleidenii*, n. sp. (Pl. 66, fig. 2).

Shell subconical, with two deep strictures. Length of the three joints = 2 : 3 : 6, breadth = 3 : 5 : 6. Cephalis subspherical. Pores subregular, circular, arranged in transverse girdles, three in the broad thorax, six in the subglobular abdomen. Basal pole rounded.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·03, *c* 0·06; breadth, *a* 0·03, *b* 0·05, *c* 0·06.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Genus 625. *Phrenocodon*,[1] n. gen.

*Definition.*—Theocapsida (vel Tricyrtida eradiata clausa) with an apical horn, and a lattice-plate between thorax and abdomen.

The genus *Phrenocodon* differs from the two preceding genera in the remarkable circumstance, that the basal lattice-plate closes not the terminal mouth itself, but the

[1] *Phrenocodon* = Bell with diaphragm; φρήν, κώδων.

constricted opening between thorax and abdomen. It may therefore be regarded as a *Sethocapsa*, which has developed a third, open, abdominal joint. The cephalis bears an apical horn.

1. *Phrenocodon clathrostomium*, n. sp. (Pl. 70, figs. 7, 8).

Shell campanulate-conical, with two deep strictures. Length of the three joints = 2 : 6 : 3, breadth = 3 : 10 : 14. Cephalis hemispherical, with an oblique curved horn of the same length. Thorax subconical, with polygonal, roundish pores, increasing in size towards the girdle. A perfect fenestrated diaphragm, with irregular, roundish pores of very different sizes, separates the thorax from the abdomen. The latter is composed of three parallel, circular rings, which are connected by fifteen to twenty radial beams. As the middle ring is larger than the two others, the beams between the large quadrangular pores are divergent in the upper, convergent in the lower girdle. Short prolongations of the divergent beams form a coronal around the middle ring (compare fig. 7 profile, fig. 8 from below).

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·03; breadth, *a* 0·03, *b* 0·1, *c* 0·14.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Phrenocodon diaphragma*, n. sp.

Shell campanulate-conical, very similar to that of the preceding species, but with abdomen and proportions different. Length of the three joints = 1 : 3 : 2, breadth = 1 : 4 : 4. Abdomen cylindrical, with two or three transverse rows of large quadrangular meshes (fifteen to twenty in each row), without the characteristic inflexion of the preceding species, and without the coronal.

*Dimensions.*—Length of the three joints, *a* 0·02, *b* 0·06, *c* 0·034; breadth, *a* 0·02, *b* 0·08, *c* 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Section IV. STICHOCYRTIDA, Haeckel, 1862, Monogr. d. Radiol., p. 280, 312 (Pls. 75–80).

*Stichocyrtida et Tetracyrtida*, Haeckel, 1881, Prodromus, p. 437, 438.

*Definition.*—Cyrtoidea polythalamia, with annulated shell, divided by three to six or more transverse, horizontal constrictions, into four to seven or more annular joints. (The first joint represents the cephalis, the second the thorax, the third the abdomen, all the following joints together a post-abdomen.)

*Synopsis of the three Families and six Subfamilies of Stichocyrtida.*

| | | |
|---|---|---|
| Family LXVIII. Podocampida. Three radial apophyses. | Mouth open, | Stichopilida. |
| | Mouth closed, | Stichoperida. |
| Family LXIX. Phormocampida. Numerous radial apophyses. | Mouth open, | Stichophormida. |
| | Mouth closed, | Stichophænida. |
| Family LXX. Lithocampida. No radial apophyses. | Mouth open, | Stichocorida. |
| | Mouth closed, | Stichocapsida, |

## Family LXVIII. PODOCAMPIDA, n. fam.

*Artopilida et Artoperida, Stichopilida et Stichoperida*, Haeckel, 1881, Prodromus, p. 437–439.

*Definition.*—Stichocyrtida triradiata. (Cyrtoidea with an annulated shell, divided by three or more transverse constrictions into four or more annular joints, and bearing three radial apophyses).

The family Podocampida comprises those Cyrtoidea in which the lattice-shell is composed of numerous (four to eight or more) annular joints, and bears three external radial apophyses. It may be divided into two subfamilies, differing in the shape of the terminal mouth. This is a simple wide opening in the Stichopilida (and the united Artopilida), closed by a lattice-plate in the Stichoperida (and the united Artoperida). The phylogenetic origin of the Podocampida may be found in the Podocyrtida (p. 1314).

Very few forms only of the Podocampida were hitherto known, viz., *Stichopilium* (*Pterocodon*) *davisianum*, and three fossil species from Barbados, figured by Ehrenberg; *Artopera loxia* (united by him with *Lithornithium*), and two species of *Pteropilium* (*sphinx* and *bombus*, both united by him with the three-jointed *Pterocanium*). In general, the triradiate Stichocyrtida are much rarer and much poorer in specific forms than the triradiate Tricyrtida, their ancestors. We have observed altogether only forty-four species, thirty Stichopilida, and fourteen Stichoperida; the former are disposed among seven, the latter among three genera.

The three radial apophyses appear either as lateral ribs or prominent wings in the thorax (Pl. 77, fig. 8–12), or as three terminal feet around the mouth (Pl. 97, fig. 15). Sometimes the ribs are replaced by three radial combs, or rows of spines, and these may be united by three divergent beams, forming three vaulted bridges with numerous bows (Pl. 75, figs. 10, 11). The lateral wings or ribs, as well as the terminal feet, are either solid or fenestrated.

*Synopsis of the Genera of Podocampida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Stichopilida. Mouth of the terminal joint a simple wide opening. | Three lateral appendices or wings (no terminal feet). | Lateral wings are solid spines. | Cephalis with horn, | 626. *Stichopilium.* |
| | | Lateral wings are latticed. | With horn, | 627. *Artopilium.* |
| | | | Without horn, | 628. *Pteropilium.* |
| | Three terminal appendices or feet at the peristome (all with cephalic horn). | Three lateral ribs or crests prolonged into the three terminal feet. | Feet solid, | 629. *Stichocampe.* |
| | | | Feet latticed, | 630. *Stichopterium.* |
| | | No lateral ribs. Three terminal feet free. | Feet solid, | 631. *Podocampe.* |
| | | | Feet latticed, | 632. *Stichopodium.* |
| II. Subfamily Stichoperida. Mouth of the terminal joint closed by a lattice-plate. | Last joint rounded, without a vertical basal spine (cephalis with horn). | Three lateral solid ribs (or rows of spines), | | 633. *Stichopera.* |
| | | Three lateral latticed wings (or rows of wings), | | 634. *Cyrtopera.* |
| | Last joint conical, pointed, with a vertical basal spine. | Three lateral solid ribs (cephalis with an apical horn), | | 635. *Artopera.* |

Subfamily 1. STICHOPILIDA, Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Podocampida with the terminal mouth of the shell open (vel Stichocyrtida triradiata aperta).

Genus 626. *Stichopilium*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichopilida (vel Stichocyrtida triradiata aperta) with three solid lateral ribs or wings, without terminal feet. Cephalis with a horn.

The genus *Stichopilium* is the most primitive among all Stichocyrtida, and represents perhaps the common ancestral form of this family. The shell is composed of four or more joints (sometimes ten to twelve), has a wide open terminal mouth, and three lateral solid wings or ribs (sometimes a little latticed on the base). *Stichopilium* may be derived from *Theopilium* or *Pterocorys* by addition of new terminal joints.

Subgenus 1. *Triacartus*, Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Shell with three annular strictures, and four distinct joints.

[1] *Stichopilium*=Hat with a row of joints; στίχος, πίλιον.

1 *Stichopilium cortina*, n. sp.

Shell ovate, with three sharp strictures. Length of the four joints = 2 : 6 : 3 : 4. Cephalis subspherical, with a slender pyramidal horn of twice the length. The three edges of the horn are prolonged into three strong divergent ribs, along the three first joints, and into three free conical lateral spines, directed downwards, on the end of the third joint. The fourth joint is subcylindrical; its circular, terminal mouth half as broad as the third joint, which is the broadest. Pores small, regular, hexagonal, with thin bars.

*Dimensions.*—Length of the shell (with four joints) 0·15, breadth 0·08. Length of the single joints, *a* 0·02, *b* 0·06, *c* 0·03, *d* 0·04.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Stichopilium costatum*, n. sp.

Shell conical, or nearly pyramidal, with three distinct strictures. Length of the four joints = 3 : 5 : 8 : 4. Cephalis subconical, with a stout pyramidal horn of the same length. Thorax campanulate, with six longitudinal ribs, from three of which in the middle arise three horizontal, conical, free spines or wings, about as long as the cephalis. The third large prismatic joint bears twelve parallel ribs, six new ribs being intercalated between the six former. Fourth joint short, cylindrical, without ribs, the wide open mouth not constricted, nearly as broad as the third joint, which is the broadest. Pores small, irregular, polygonal, or roundish.

*Dimensions.*—Length of the shell (with four joints) 0·2, breadth 0·12. Length of the single joints, *a* 0·03, *b* 0·05, *c* 0·08, *d* 0·04.

*Habitat.*—North Pacific, Station 244 (off Japan), depth 2900 fathoms.

3. *Stichopilium bicorne*, n. sp. (Pl. **77**, fig. 9).

Shell conical, with three slight strictures. Length of the four joints = 4 : 14 : 5 : 3. Cephalis large, conical, with two stout pyramidal, divergent horns of twice the length. From its base (in the middle of the collar stricture) arise three internal, downwardly divergent ribs, which are prolonged on the outside of the upper half of the thorax into three stout, pyramidal, lateral spines (similar to the horns). The fourth joint, with wide open mouth, was the broadest, but not fully developed in the single specimen observed. Pores subregular, hexagonal, with thin bars.

*Dimensions.*—Length of the shell (with four joints) 0·02, breadth 0·09. Length of the single joints, *a* 0·02, *b* 0·07, *c* 0·025, *d* 0·015.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Stichopilium davisianum*, Haeckel.

*Pterocodon davisianus*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 298, Taf. ii. fig. 10.
*Cycladophora davisiana*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 289, Taf. ii. fig. 11.
*Eucyrtidium davisianum*, Haeckel, 1862, Monogr. d. Radiol., p. 328.
*Pterocanium davisianum*, Haeckel, 1862, Monogr. d. Radiol., p. 332.

Shell campanulate, conical, with three slight strictures. Length of the four joints = 2 : 3 : 4 : 3. Cephalis hemispherical, with few small pores and a short conical horn. Thorax campanulate, with

larger circular pores, and three recurved, divergent, lateral wings of the same length. Third and fourth joints each with three transverse rows of very large hexagonal pores. The similar form described by Ehrenberg as *Cycladophora davisiana*, is either a mutilated specimen, or belongs to *Lithostrobus*.

*Dimensions.*—Length of the shell (with four joints) 0·12, breadth 0·08. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·04, *d* 0·03.

*Habitat.*—North Atlantic, Greenland, depth 1000 to 1500 fathoms.

### 5. *Stichopilium campanulatum*, n. sp. (Pl. 77, fig. 11).

Shell campanulate, with three slight strictures. Length of the four joints = 3 : 5 : 5 : 4. Cephalis subovate, with an internal rod-cross, and a stout pyramidal horn of the same length. From the middle of the collar stricture arise three divergent collar beams, which descend in the upper half of the campanulate thorax as three divergent ribs, and are prolonged into three free horizontal spines. (In the specimen figured these three wings are very short; in another specimen, found afterwards, there were three solid, pyramidal, horizontal spines, as long as the cephalic horn.) The third joint is the broadest, of about the same length as the fourth. (The annular septum between the two latter is by a mistake not figured). Pores subregular, circular, hexagonally framed.

*Dimensions.*—Length of the shell (with four joints) 0·17, breadth 0·12. Length of the single joints, *a* 0·03, *b* 0·05, *c* 0·05, *d* 0·04.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 6. *Stichopilium triserratum*, n. sp.

Shell slenderly campanulate, with three deep strictures. Length of the four joints = 2 : 4 : 6 : 3. Cephalis hemispherical, with a stout pyramidal horn three times the length. The three edges of the horn are prolonged into three strong prominent ribs along the three first joints; each rib bears a series of stout, irregular, triangular teeth. The fourth joint is without ribs; its constricted mouth is half as broad as the third (broadest) joint. Pores subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·15, breadth 0·08. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·06, *d* 0·03.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Subgenus 2. *Stichopilidium*, Haeckel.

*Definition.*—Shell with four or more annular strictures and five or more joints.

### 7. *Stichopilium macropterum*, Haeckel.

*Rhopalocanium varietas*, Bury, 1862, Polycystins of Barbados, pl. xvii. fig. 7.

Shell slenderly conical, with five deep strictures. Length of the six joints = 2 : 5 : 4 : 3 : 3 : 6. Cephalis hemispherical, with a stout conical horn of twice the length. Thorax campanulate, with

three large, triangular, widely divergent wings or ribbed solid spines, nearly as long as the shell. The breadth of the joints increases gradually; the last joint is the broadest, with wide open mouth. Pores subregular, circular.

*Dimensions.*—Length of the shell (with six joints) 0·23, breadth 0·1. Length of the single joints, *a* 0·02, *b* 0·05, *c* 0·04, *d* 0·03, *e* 0·03, *f* 0·06.

*Habitat.*—Fossil in Barbados.

8. *Stichopilium pectinatum*, n. sp.

Shell slenderly conical, with nine sharp strictures. All ten joints have nearly equal length, and increase gradually in breadth; the last joint is the broadest, and twice as long as each of the others, with wide open mouth. Cephalis subspherical, with a conical horn of the same length. Each joint (excepting the first and the last) bears three lateral, nearly horizontal spines, and the bases of all the spines are connected by three longitudinal, divergent ribs. Pores subregular, hexagonal. (Similar to *Stichopera pectinata*, Pl. **75**, fig. 11.)

*Dimensions.*—Length of the shell (with ten joints) 0·32, breadth 0·1.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

9. *Stichopilium thoracopterum*, n. sp.

Shell slenderly ovate, twice as long as broad, with eleven slight annular strictures. The twelve joints (excepting the second) are of nearly equal length, or alternately longer and shorter. The eighth joint is the broadest, one and a half times as broad as the slightly constricted mouth. Cephalis small, hemispherical, with a pyramidal horn of twice the length. Thorax (or second joint) campanulate, twice to three times as long as each of the eleven other joints, with three longitudinal ribs, prolonged into three divergent, slender, free spines. Pores small, regular, hexagonal.

*Dimensions.*—Length of the shell (with twelve joints) 0·22, breadth 0·11. Length of each joint (on an average) 0·015 to 0·017, thorax 0·035.

*Habitat.*—South Pacific, Station 296, depth 1825 fathoms.

## Genus 627. *Artopilium*,[1] Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Stichopilida (vel Stichocyrtida triradiata aperta) with three latticed lateral ribs or wings, without terminal feet. Cephalis with a horn.

The genus *Artopilium* (including also the genera *Trictenartus*, *Pterocorythium*, *Stichopterygium*, and *Clathropyrgus* of my Prodromus) has a shell of the same form as the preceding *Stichopilium*, but it differs in the fenestration of the three lateral ribs or wings, which in the latter are solid. The limit between the two genera is often not

[1] *Artopilium* = Loaf-hat; ἄρτος, πίλιον.

sharp. *Artopilium* may be also derived from the three-jointed *Dictyoceras* by addition of new terminal joints.

Subgenus 1. *Trictenartus*, Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Shell with three annular strictures and four joints.

1. *Artopilium elegans*, n. sp. (Pl. 75, fig. 1).

Shell three-sided pyramidal, with three annular strictures. Length of the four joints = 1:2:9:3. Cephalis small, hemispherical, with two large, prismatic, divergent horns of three times the length. The three prominent edges of the second and third joints are finely latticed and dentated, and at the basal end of the third joint are prolonged into three stout, free, pointed, pyramidal, divergent wings, about as long as the horns. The fourth joint is only as long as the second, three-sided prismatic, its wide triangular mouth is armed with six parallel, vertical, slender teeth (two between every three wings). Network very delicate and regular, in the first and second joints with circular, in the third and fourth joints with small hexagonal meshes.

*Dimensions.*—Length of the shell (with four joints) 0·3, breadth of the third joint 0·3, of the fourth 0·2. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·18, *d* 0·06.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

2. *Artopilium longicorne*, n. sp. (Pl. 77, fig. 10).

Shell subovate, with three internal annular septa. Length of the four joints = 2 : 3 : 2 : 6. Cephalis hemispherical, with a very large three-sided prismatic horn, nearly as long as the shell. Along the three following joints arise three broad, triangular, latticed wings, about as long as the shell. The fourth joint is the broadest, and twice as broad as the constricted mouth. Pores in the two upper joints regular, circular, in the two lower and the three wings hexagonal.

*Dimensions.*—Length of the shell (with four joints) 0·13, breadth 0·09. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·02, *d* 0·06.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

3. *Artopilium cyrtopterum*, n. sp. (Pl. 77, fig. 12).

Shell subovate, with three sharp strictures. Length of the four joints = 1 : 2 : 3 : 3. Cephalis subspherical, with a stout, pyramidal horn of twice the length. Along the second and third joints arise three broad, triangular, latticed wings, about half as long as the shell. The third joint is the broadest, and twice as broad as the constricted mouth. Pores subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·1. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·06, *d* 0·06.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

Subgenus 2. *Clathropyrgus*, Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Shell with four or more annular strictures, and five or more joints.

4. *Artopilium trifenestra*, n. sp. (Pl. 75, fig. 7).

*Clathropyrgus trifenestra*, Haeckel, 1881, Prodromus et Atlas (*loc. cit.*).

Shell tower-shaped, nearly cylindrical, with nine deep strictures. The ten joints are of different lengths and breadths. The third and fourth joints are the longest, twice as long as the first, fifth, sixth, eighth, and ninth joints. The third, seventh, and tenth joints are the broadest, and nearly twice as broad as the second and ninth joints. The mouth of the last joint is dilated. The second joint bears three divergent ribs, and the third joint (as prolongations of these) three broad, triangular, lattice-wings, and between the latter three large, ovate openings or windows, recalling those in *Clathrocanium* (Pl. 64). Cephalis subspherical, with a pyramidal horn of twice the length. Pores subregular, circular, hexagonally framed.

*Dimensions.*—Length of the shell (with ten joints) 0·28, of the first and ninth joints 0·02, of the third and fourth joints 0·04; breadth of the third and seventh joints 0·08, of the second and ninth joints 0·04.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

5. *Artopilium trigonopterum*, n. sp.

Shell in the upper half campanulate-conical, in the lower half cylindrical, with seven internal septa. The four middle joints are equal in length, each about twice as long as each of the two first and of the two last joints. Cephalis hemispherical, with a conical horn of the same length. Along the first three joints arise three broad, triangular, lattice-wings. Pores small, regular, hexagonal, in the wings and the two first joints circular. The five lower joints are of equal breadth.

*Dimensions.*—Length of the shell (with eight joints) 0·2, breadth 0·1. Length of the four middle joints, each about 0·034, of the two first and the two last, each 0·017.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

6. *Artopilium cornutella*, n. sp.

Shell slenderly conical, without external strictures, but with twelve to fifteen internal annular septa. All thirteen to sixteen joints are nearly equal or slightly different in length, but increase gradually in breadth. Along the whole shell arise three narrow, divergent lattice-wings, increasing in height towards the wide open mouth. Pores subregular, square, in three to four transverse rows on each joint, half as large in the three wings as in the joints. Cephalis small, subspherical, with a conical horn of twice the length. (In the specimen described the axis of the slender cone was straight, in another incomplete specimen curved; this may perhaps be a separate species, *Artopilium curvatum*.)

*Dimensions.*—Length of the shell (with sixteen joints) 0·3, basal breadth 0·12. Length of each single joint (on an average), 0·02.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 7. *Artopilium stichopterygium*, n. sp. (Pl. 75, fig. 8).

*Stichopterygium tanypterum*, Haeckel, 1881, Prodromus, p. 439, et Atlas.

Shell slenderly ovate, subconical, with five deep strictures. The four lower joints are nearly equal in length, each about twice as long as each of the first two joints. The fourth and fifth joints are the broadest. Along the whole shell arise three broad, triangular wings, which envelop the long, slender, pyramidal horn of the cephalis. In the delicate and loose lattice-work of each wing is a longitudinal series of six large, ovate apertures, one on each joint. The small pores of the shell are irregular, polygonal, or roundish.

*Dimensions.*—Length of the shell (with six joints) 0·17, breadth 0·08. Length of each of the four lower joints 0·03, of each of the two upper joints 0·015.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 8. *Artopilium anomalum*, Haeckel.

*Eucyrtidium anomalum*, Haeckel, 1862, Monogr. d. Radiol., p. 323, Taf. vii. figs. 11–13.
*Lithocampe anomala*, Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 839.
*Stichopterygium anomalum*, Haeckel, 1881, Prodromus, p. 439.

Shell five-jointed, with four internal septa, of a peculiar, irregular, and abnormal form. Cephalis small, hemispherical, with an oblique, curved horn. Thorax inflated, campanulate, with three large, latticed, and carinated protuberances. The third joint (the first abdominal joint) nearly as large as the thorax, two to three times as long as the two last joints, the septa of which are connected in a peculiar manner by a common nodal point on one side. Pores subregular, circular. (Compare the detailed description of this remarkable species—perhaps the type of a peculiar genus, *Stichopterygium*—in my Monograph, *loc. cit.*)

*Dimensions*—Length of the shell (with five joints) 0·15, breadth 0·1.

*Habitat.*—Mediterranean (Messina), surface.

## Genus 628. *Pteropilium*,[1] n. gen.

*Definition.*—Stichopilida (vel Stichocyrtida triradiata aperta) with three latticed external ribs or wings, without terminal feet. No horn upon the cephalis.

The genus *Pteropilium* (confounded by Ehrenberg with *Pterocanium*) differs from this three-jointed form by addition of new terminal joints. The shell-form is in general the same as in the preceding species, from which it may be derived by phylogenetic loss of the cephalic horn.

[1] *Pteropilium*=Winged hat; πτερόν, πίλιον.

1. *Pteropilium sphinx*, Haeckel.

*Pterocanium sphinx*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 255, Taf. xvii. fig. 5.

Shell slenderly conical, with three slight strictures. Each of the two last joints as long as the two first joints together. Cephalis hemispherical. Third joint with three prominent, divergent ribs, which are prolonged along the fourth joint into three latticed, triangular wings, ending in a free, strong, conical spine. Pores subregular, circular, twice as broad in the fourth joint as in the third, and three times as broad as in the second joint.

*Dimensions.*—Length of the shell (with four joints) 0·15, of the single joints, *a* 0·02, *b* 0·03, *c* 0·05, *d* 0·05 ; breadth of the third joint 0·09, of the fourth joint 0·06.

*Habitat.*—Fossil in Barbados.

2. *Pteropilium bombus*, Haeckel.

*Pterocanium bombus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 82, Taf. xvii. fig. 4.

Shell broadly conical, with three deep strictures. Length and breadth of the four joints, gradually increasing giving the proportion 2 : 4 : 5 : 6. Cephalis hemispherical, second joint with three prominent ribs, which are prolonged along the third and fourth joints into three slender, triangular pointed wings, with few pores at the base. Pores of the shell subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·17, of the single joints, *a* 0·02, *b* 0·04, *c* 0·05, *d* 0·06 ; basal breadth 0·11.

*Habitat.*—Fossil in Barbados.

3. *Pteropilium pyramis*, n. sp.

Shell three-sided, pyramidal, with five deep strictures. Length and breadth of the six joints gradually increasing towards the wide mouth. Cephalis subconical. Along the four first joints arise three slender, divergent ribs, which at the fifth joint become three free, triangular, latticed wings, with long, descending, terminal spines. The sixth joint is free, without wings. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with six joints) 0·2, basal breadth 0·2.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

Genus 629. *Stichocampe*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichopilida (vel Stichocyrtida triradiata aperta) with three solid lateral ribs or wings, which are prolonged into three solid terminal feet. Cephalis with a horn.

[1] *Stichocampe* = Caterpillar with a row of joints; στίχος, κάμπη.

The genus *Stichocampe*, together with the three following genera, represent a peculiar small group among the Stichocyrtida, differing from all other members of this family in the possession of three free terminal feet around the open mouth. In the two genera, *Stichocampe* and *Stichopterium*, these three feet are the terminal prolongations of three lateral ribs or crests, while in the two genera developed later, *Podocampe* and *Stichopodium*, the three original ribs are lost, and only the three free feet remain. *Stichocampe* (the most primitive of these four genera) may be derived from *Theopodium* by addition of new joints.

1. *Stichocampe divergens*, n. sp.

Shell spiny, broadly pyramidal, with six deep strictures. Seven joints gradually increasing in breadth and length, the seventh twice as broad as the fourth. Pores subregular, circular, hexagonally framed. The prominent edges of the pyramis are prolonged over the wide mouth into three slender, straight, divergent feet, half as long as the shell.

*Dimensions.*—Length of the shell (with seven joints) 0·3, of the last joint 0·06, of the fourth 0·03 ; breadth 0·25.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Stichocampe convergens*, n. sp.

Shell smooth, slenderly pyramidal, with eight distinct strictures. All nine joints nearly equal in length. Pores regular, circular, forming three or four transverse rows in each joint. The smooth edges of the pyramis are prolonged over the wide mouth into three slender, slightly curved, and convergent feet, twice as long as one joint.

*Dimensions.*—Length of the shell (with nine joints) 0·25, of each joint, about 0·35 ; breadth 0·11.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

## Genus 630. *Stichopterium*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichopilida (vel Stichocyrtida triradiata aperta), with three lateral ribs or wings, which are prolonged into three latticed, terminal feet. Cephalis with a horn.

The genus *Stichopterium* has in general the same shell-formation as the nearly allied *Stichocampe*, but differs from this ancestral form in the fenestration of the three terminal feet. It corresponds, therefore, to *Pterocanium* among the Tricyrtida.

[1] *Stichopterium* = Row-wing; στίχος, πτέριον.

1. *Stichopterium pterocanium*, n. sp.

Shell campanulate, with three distinct strictures. Length of the four joints = 2 : 3 : 4 : 3. Cephalis subspherical, with a conical horn of twice the length. Pores regular, hexagonal, with thin bars. From the collar stricture arise three divergent ribs, which in the fourth joint become latticed and prolonged over its mouth into three slender, pyramidal, latticed, divergent feet, nearly as long as the shell. (Similar to *Pterocanium bicorne*, Pl. **73**, fig. 5, but with four distinct strictures.)

*Dimensions.*—Length of the shell (with four joints) 0·12, breadth 0·1. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·04, *d* 0·03.

*Habitat.*—South Pacific (off Patagonia), Station 304, surface.

2. *Stichopterium virgineum*, n. sp.

Shell three-sided, pyramidal, with four sharp strictures. Length of the five joints = 1 : 4 : 3 : 2 : 1. Cephalis hemispherical, with a pyramidal horn three times the length. Pores subregular, circular, in the second campanulate joint twice or three times as broad as in the four other joints. From the base of the cephalic horn arise three divergent ribs, which descend over the whole shell, and in the fourth joint become latticed and prolonged over the wide mouth of the fifth joint into three latticed, pyramidal feet, as long as the second joint. (Similar in general form to *Pterocanium virgineum*, Pl. **73**, fig. 6.)

*Dimensions.*—Length of the shell (with five joints) 0·22, breadth 0·16. Length of the single joints, *a* 0·02, *b* 0·08, *c* 0·06, *d* 0·04, *e* 0·02.

*Habitat.*—Central Pacific, Station 281, surface.

3. *Stichopterium dictyopodium*, n. sp.

Shell subovate, with five internal annular septa. The third and the fourth joints are about twice as long as the two first and the two last joints. The fifth joint is the broadest. Pores small and numerous, regular, circular. The three first joints are without ribs. From the third stricture arise three divergent, triangular, latticed wings, which descend along the three last joints, and are prolonged over the wide mouth as three slender, fenestrated, divergent feet, two-thirds as long as the shell.

*Dimensions.*—Length of the shell (with six joints) 0·18, breadth 0·12. Length of the two middle joints 0·04, of the four others 0·02 to 0·03.

*Habitat.*—South Pacific, Station 288, surface.

## Genus 631. *Podocampe*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichopilida (vel Stichocyrtida triradiata aperta), without lateral ribs or wings, but with three free, solid, terminal feet. Cephalis with a horn.

[1] *Podocampe* = Caterpillar with feet; *πούς, κάμπη*.

The genus *Podocampe* is next allied to *Stichocampe*, and has also three solid, free feet around the mouth, but it has lost the three lateral ribs of the latter. It corresponds to *Podocyrtis* among the Tricyrtida, and may be derived from this by addition of new terminal joints.

1. *Podocampe tripodiscus*, n. sp.

Shell ovate, with three annular septa. The fourth joint is the broadest, and as long as the three other joints together. Cephalis hemispherical, with a pyramidal horn of twice the length. Mouth constricted, with three convergent, curved, triangular feet, half as long as the last joint. Pores subregular, circular. (Similar to *Podocyrtis pedicellaria*, Pl. **72**, fig. 8, but larger, with more slender feet, and four joints instead of three.)

*Dimensions.*—Length of the shell (with four joints) 0·2, of the last joint 0·1; breadth 0·12.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

2. *Podocampe trictenota*, n. sp. (Pl. **97**, fig. 15).

Shell slenderly ovate, nearly spindle-shaped, with three annular septa. The third joint is the broadest, somewhat longer than the second and third joints, and three times as long as the hemispherical cephalis, which bears a strong pyramidal horn of twice the length. Along the two first joints arise three divergent, dentate crests, each with four to six strong pyramidal teeth. Mouth strongly constricted, only as broad as the cephalis, with three conical, vertical, parallel feet, as long as the cephalis. Pores regular, circular, hexagonally framed.

*Dimensions.*—Length of the shell (with four joints) 0·14, of the third joint 0·06, of the last 0·04; breadth 0·08.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

3. *Podocampe conica*, n. sp.

Shell conical, with five distinct strictures. Six joints gradually increasing in length and breadth. The sixth joint is the broadest, and twice as long as the fifth joint, three times as long as the fourth. Cephalis conical, with a stout, conical horn of the same length. Mouth little constricted, with three divergent, conical feet, half as long as the shell. Pores subregular, circular. (Similar to *Podocyrtis lithoconus*, Pl. **72**, fig. 3, but with six joints instead of three, and with divergent, slender feet.)

*Dimensions.*—Length of the shell (with six joints) 0·18, of the last joint 0·06; breadth 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Podocampe cornuta*, n. sp.

Shell slenderly conical, with seven distinct strictures. Eight joints of nearly equal length, gradually increasing in breadth. Along the three last joints arise three prominent crests, which are

prolonged over the wide mouth into three divergent, conical feet, half as long as the shell. Cephalis hemispherical, with a conical, slender, curved horn, three times the length. Pores subregular, hexagonal.

*Dimensions.*—Length of the shell (with eight joints) 0·16, of each single joint (on an average) 0·02; basal breadth 0·07.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 632. *Stichopodium*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichopilida (vel Stichocyrtida triradiata aperta) without lateral ribs or wings, but with three free latticed terminal feet. Cephalis with a horn.

The genus *Stichopodium* differs from the preceding genus *Podocampe* in the fenestration of the three free terminal feet. It agrees in this character with the genus *Stichopterium*, and may be derived either from this by loss of the lateral ribs, or from the three-jointed *Pterocanium* by addition of new shell-joints.

1. *Stichopodium dictyopodium*, n. sp. (Pl. 75, fig. 6).

Shell subcylindrical, in the upper third conical, with six or seven internal annular septa. All seven or eight joints are about equal in length, except the small hemispherical cephalis, which is scarcely half as long, and bears an oblique, conical horn of the same length. Pores small and numerous, regular, circular, quincuncial. The last joint with wide open mouth, and a peristome of three large, triangular, latticed, shovel-shaped, vertical feet.

*Dimensions.*—Length of the shell (with seven joints) 0·2, breadth 0·11. Length of each single joint about 0·03, of the feet 0·03.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Subfamily 2. STICHOPERIDA, Haeckel, Prodromus, p. 439.

*Definition.*—Podocampida with the terminal mouth of the shell fenestrated (vel Stichocyrtida triradiata clausa).

Genus 633. *Stichopera*,[2] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichoperida (vel Stichocyrtida triradiata clausa) with three solid lateral ribs, or three longitudinal combs of spines. Cephalis with a horn.

[1] *Stichopodium* = Row-foot; στίχος, ποδίον.

[2] *Stichopera* = Row-pouch; στίχος, πήρα.

The genus *Stichopera*, and the two following genera, represent the small subfamily of Stichoperida, or those triradiate Stichocyrtida in which the terminal mouth is closed by lattice-work. In *Stichopera* the three radial appendages are either solid lateral ribs or longitudinal combs of spines; the closed basal part of the shell is rounded, not pointed. It may be derived either from *Stichopilium* by closure of the mouth, or from *Lithornithium* by increase of the number of the joints.

### Subgenus 1. *Stichoperina*, Haeckel.

*Definition.*—Shell with three solid radial ribs, or longitudinal dentate crests.

#### 1. *Stichopera ovata*, n. sp.

Shell ovate, with three distinct strictures. Length of the four joints = 2 : 3 : 4 : 6. The fourth joint is the broadest, and twice as long as the second, with hemispherical basal pole. Cephalis hemispherical, with a conical horn of twice the length. Along the second and third joints descend three prominent divergent ribs, which disappear in the middle zone of the fourth joint. Pores regular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·15, breadth 0·1. Length of the single joint, *a* 0·02, *b* 0·03, *c* 0·04, *d* 0·06.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

#### 2. *Stichopera lagena*, n. sp.

Shell bottle-shaped, with six sharp strictures; the upper half is slender, conical, and composed of six joints of nearly equal length, the lower half is formed only by the last subspherical joint. Cephalis subspherical, with a pyramidal horn of the same length. From its base arise three divergent ribs, which attain the greatest height in the fourth joint, and disappear in the sixth joint. (Similar to *Stichophœna ritteriana*, Pl. **75**, fig. 12, but only with three ribs and seven joints.) Pores regular, hexagonal.

*Dimensions.*—Length of the shell (with seven joints) 0·25. Length of each joint 0·02 to 0·025, of the last joint 0·12; breadth 0·14.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

#### 3. *Stichopera serrata*, n. sp.

Shell bottle-shaped, with eight deep strictures. The first eight joints are little different in length, and form together a slender cone, while the last joint is four times as long (half as long as this cone), and subspherical. Cephalis conical, with a slender, prismatic horn of three times the length. Along the whole shell arise three divergent, serrate ribs, which disappear towards the hemispherical, basal pole. Pores subregular, hexagonal.

*Dimensions.*—Length of the shell (with nine joints) 0·21, breadth 0·08 ; length of each joint 0·016 to 0·019, of the last joint 0·07.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

## Subgenus 2. *Sticholagena*, Haeckel.

*Definition.*—Shell with three radial combs or longitudinal rows of isolated spines (instead of the three radial ribs).

### 4. *Stichopera pectinata*, n. sp. (Pl. 75, fig. 11).

Shell club-shaped, with nine sharp strictures. The nine upper joints increase gradually in length and breadth, and are together three times as long as the inflated, inversely campanulate and rounded last joint. Each joint (excepting the first and the last) bears three thin, bristle-shaped spines, which are directed obliquely upwards. Cephalis subspherical, with a slender, conical horn of twice the length. Pores subregular, in the upper half circular, in the lower hexagonal.

*Dimensions.*—Length of the shell (with ten joints) 0·22, breadth 0·09 ; length of the eighth and ninth joints 0·02, of the last joint 0·075.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

### 5. *Stichopera clavata*, n. sp.

Shell club-shaped, with eight sharp strictures, very similar in form and structure to that of the preceding species, but differing from it in the club-like form of the inflated last joint, which is nearly half as long as the shell ; its lower half is broader than the upper (the reverse being the case in the preceding species). The lateral spines of the three combs are not directed upwards, but downwards. Cephalis with a curved, conical horn of the same length.

*Dimensions.*—Length of the shell (with nine joints) 0·2, breadth 0·08 ; length of the eighth joint 0·02, of the last joint 0·09.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

### 6. *Stichopera verticillata*, n. sp.

Shell club-shaped, with ten sharp strictures, similar in form and structure to that of the two preceding species, but differing from them in the ovate form of the slender last joint, which is one-third as long as the whole shell, and five times as long as the preceding joint. The lateral spines of the three combs are directed nearly horizontally, and are much more numerous, each joint (excepting the first and last) bears six to twelve spines (two, three, or four in each radius). They form together about thirty horizontal verticils, each with three spines. Cephalis with a curved, conical horn of three times the length.

*Dimensions.*—Length of the shell (with eleven joints) 0·28, breadth 0·09; length of the tenth joint 0·02, of the last joint 0·1.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 634. *Cyrtopera*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichoperida (vel Stichocyrtida triradiata clausa) with three latticed lateral wings, or three longitudinal rows of lattice-wings. Cephalis with a horn.

The genus *Cyrtopera* differs from the preceding *Stichopera* in the fenestration of the three lateral wings, and bears therefore to it the same relation that *Sethornithium* exhibits to *Lithornithium* among the Tricyrtida.

Subgenus 1. *Artopera*, Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Shell with three annular strictures and four joints.

1. *Cyrtopera thoracoptera*, n. sp. (Pl. 75, fig. 3).

*Artopera thoracoptera*, Haeckel, 1881, Prodromus et Atlas (*loc cit.*).

Shell inflated, with three very deep strictures. Length of the four joints = 2 : 7 : 8 : 6. Cephalis hemispherical, with a slender, prismatic horn, half as long as the shell. Thorax subspherical, in its middle third with three latticed, triangular wings of half the length. Abdomen with inflated third, and inversely hemispherical fourth joint; the third is the broadest. Pores subregular, hexagonal, with thin bars.

*Dimensions.*—Length of the shell (with four joints) 0·23. Breadth of the third (broadest) joint 0·13. Length of the single joints, *a* 0·02, *b* 0·07, *c* 0·08, *d* 0·06.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Cyrtopera ornithoptera*, n. sp.

Shell broadly ovate, with three slight strictures. Length of the four joints = 1 : 2 : 3 : 4. Cephalis hemispherical, with a slender, pyramidal horn of three times the length. Along the second and third joints arise with broad base three latticed, triangular wings, nearly as long as the whole shell. Abdomen inflated. The fourth joint is the broadest and longest, with hemispherical basal pole. Pores subregular, hexagonal. (Similar to *Artopilium longicorne*, Pl. 77, fig. 10, but with more closely reticulated network, and perfectly closed mouth.)

*Dimensions.*—Length of the shell (with four joints) 0·2. Breadth of the fourth (broadest) joint 0·14. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·06, *d* 0·08.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

[1] *Cyrtopera* = Basket-pouch; κύρτος, πήρα.

3. *Cyrtopera gasteroptera*, n. sp.

Shell slenderly ovate, with three distinct strictures. Length of the four joints = 2 : 6 : 7 : 6. Cephalis subspherical, with a stout pyramidal horn of the same length. The three following joints have nearly equal length; the third is the broadest. The thorax exhibits three divergent solid ribs; as prolongations of these, three descending latticed wings, of about the same length, arise from the third joint, with broad triangular base. The fourth joint is inversely conical, blunt. Pores irregular, roundish. (Similar to *Hexalatractus fusiformis*, Pl. 68, fig. 13, but with three wings and four joints.)

*Dimensions.*—Length of the shell (with four joints) 0·21. Breadth of the third (broadest) joint 0·11. Length of the single joints, *a* 0·02, *b* 0·06, *c* 0·07, *d* 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Subgenus 2. *Cyrtolagena*, Haeckel, 1879, Atlas (Pl. 75).

*Definition.*—Shell with four or more annular strictures, and five or more joints.

4. *Cyrtopera laguncula*, n. sp. (Pl. 75, fig. 10).

*Cyrtolagena laguncula*, Haeckel, 1879, Manuscript et Atlas (*loc. cit.*).

Shell bottle-shaped, with seven sharp strictures; the upper part is slender, conical, composed of seven joints of nearly equal length; the lower part is only formed by the spherical last joint. Cephalis subspherical, with a slender curved horn of three times the length. Along the whole shell arise three longitudinal combs or rows of ascending spines (three on each joint, fifteen on the last). These are connected by three divergent longitudinal rods, so that three elegant fenestrated ribs are formed (each rib with one series of large square meshes). Pores in the seven upper joints regular, circular, in the last polygonal, irregular and larger.

*Dimensions.*—Length of the shell (with eight joints) 0·17, of the last joint 0·08; breadth 0·08.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

5. *Cyrtopera lagenella*, n. sp.

Shell bottle-shaped, with twelve sharp strictures, very similar in form and structure to the preceding species; but instead of the three simple fenestrated ribs there arise here, along the shell, three series of short, triangular, latticed wings. The four first and the last joints are without wings. The hemispherical cephalis bears a curved conical horn, as long as the subspherical last joint. The twelve joints of the upper conical part are nearly equal in length, with regular, small, hexagonal pores. The last inflated joint is one-third as long as the shell, and has larger, irregular, polygonal pores.

*Dimensions.*—Length of the shell (with thirteen joints) 0·25, of the last joint 0·08; breadth 0·1.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

Genus 635. *Artopera*,[1] Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Stichoperida with three solid lateral ribs or wings, and with a vertical basal spine on the end of the pointed last joint. Cephalis with a horn.

The genus *Artopera* differs from its ancestral genus, *Stichopera*, in the development of a vertical terminal spine on the end of the last joint, and bears therefore to it the same relation that *Rhopalatractus* exhibits to *Rhopalocanium* among the Tricyrtida.

1. *Artopera loxia*, Haeckel.

*Lithornithium loxia*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvi. fig. 8; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 78, Taf. iv. fig. 8.

Shell spindle-shaped, with three deep strictures. Length of the four joints = 2 : 5 : 5 : 4. Cephalis subspherical, hyaline, without pores, with a thick conical horn of the same length. From the two following joints, which are nearly equal in size and of campanulate form, arise, with broad base, three divergent, slender, triangular wings. The fourth joint is smaller, inversely conical, and bears on the basal pole a strong, three-sided pyramidal, vertical spine, half as long as the shell. Pores subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·07. Length of the single joints, *a* 0·02, *b* 0·055, *c* 0·055, *d* 0·05.

*Habitat.*—Fossil in Barbados.

2. *Artopera motacilla*, n. sp.

Shell spindle-shaped, with three distinct strictures. Length of the four joints = 1 : 2 : 3 : 2. Cephalis subspherical, with a conical horn of twice the length. From the second joint arise three longitudinal, smooth, divergent ribs, which are prolonged over the third joint, and terminate at the third stricture in three short, conical teeth. The fourth is inversely conical, and bears on the basal pole a strong, vertical, cylindrical spine, nearly half as long as the shell. Pores subregular, circular, hexagonally framed. (Similar to *Rhopalatractus pentacanthus*, Pl. **68**, fig. 11, but differing in the presence of three sharp strictures, and a large, conical, basal joint).

*Dimensions.*—Length of the shell (with four joints) 0·18. Breadth of third (broadest) joint 0·09. Length of the single joint, *a* 0·02, *b* 0·04, *c* 0·06, *d* 0·04.

*Habitat.*—Western Tropical Pacific (Philippine Sea), Station 198, depth 2150 fathoms.

3. *Artopera fusiformis*, n. sp.

Shell spindle-shaped, with three distinct strictures. Length of the four joints = 2 : 3 : 5 : 5. Cephalis conical, with a strong, conical horn of the same length. Along the three first joints arise

[1] *Artopera* = Bread-pouch; ἄρτος, πήρα.

three divergent, irregularly dentate ribs, which at the second joint bear stronger, pyramidal teeth, also at the third stricture a strong, terminal tooth. Fourth joint without ribs, inversely conical, with a strong, conical, terminal spine of half the length on the basal pole. Pores subregular, circular, double-edged.

*Dimensions.*—Length of the shell (with four joints) 0·15. Breadth of the third (broadest) joint 0·08. Length of the single joint, *a* 0·02, *b* 0·03, *c* 0·05, *d* 0·05.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

## Family LXIX. PHORMOCAMPIDA, n. fam.

*Artophormida et Artophænida, Stichophormida et Stichophænida,* Haeckel, 1881, Prodromus, pp. 438, 439.

*Definition.*—Stichocyrtida multiradiata. (Cyrtoidea with an annulated shell, divided by three or more transverse constrictions into four or more annular joints, with numerous, four to nine or more, radial apophyses.)

The family Phormocampida comprises those Cyrtoidea in which the lattice-shell is composed of numerous (four to eight or more) annular joints, and bears numerous (four to eight or more) radial apophyses. We divide it into two subfamilies, differing in the shape of the terminal mouth. This is a simple wide opening in the Stichophormida (and the united Artophormida), closed by a lattice-plate in the Stichophænida (and the united Artophænida). The phylogenetic origin of the Phormocampida may be found in the Phormocyrtida.

Three fossil forms only of Phormocampida were hitherto known, two of which were described by Stöhr as *Eucyrtidium acutatum* and *Lithocampe fimbriata,* the third by Ehrenberg as *Eucyrtidium barbadense;* the latter belongs to *Artophormis,* the two former to *Cyrtophormis.* All the other Phormocampida here described, forming together thirty-one species, are new; twenty-two of them belong to the Stichophormida, and nine to the Stichophænida. The latter are disposed in two, the former in four genera.

The number of the radial apophyses is sometimes six or nine, sometimes twelve or more, usually a multiple of three. They are either lateral ribs or wings (Pl. 75, figs. 2, 5, 12), or terminal feet (Pl. 77, figs. 13 to 18). Usually they are solid, not latticed, and not strongly developed. The majority of Phormocampida have probably been derived from Phormocyrtida by growth of the abdomen, which becomes annulated by transverse constrictions. Some forms, however, may be derived from similar Podocampida, by interpolation of three to six or more secondary apophyses between the three primary or perradial apophyses.

*Synopsis of the Genera of Phormocampida.*

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| I. Subfamily Stichophormida. Mouth of the terminal joint open, simple. | Shell conical or pyramidal. Mouth wide open, not constricted. | Lateral ribs prolonged into the terminal feet, . . . . | 636. *Stichophormis.* |
| | | No lateral ribs. Feet free, terminal, . . . . . | 637. *Phormocampe.* |
| | Shell ovate or spindle-shaped. Mouth more or less constricted. | Lateral ribs prolonged into the terminal feet, . . . . | 638. *Artophormis.* |
| | | No lateral ribs. Feet free, terminal, . . . . . | 639. *Cyrtophormis.* |
| II. Subfamily Stichophænida. Mouth of the terminal joint closed by a lattice-plate. | Six radial ribs or wings, . . . . . | | 640. *Artophæna.* |
| | Nine radial ribs or wings, . . . . . | | 641. *Stichophæna.* |

Subfamily 1. STICHOPHORMIDA, Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Phormocampida with the terminal mouth of the shell open (vel Stichocyrtida multiradiata aperta).

Genus 636. *Stichophormis*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichophormida (vel Stichocyrtida multiradiata aperta) with conical or pyramidal shell, bearing in its wall numerous lateral ribs, which are prolonged into terminal feet. Mouth not constricted.

The genus *Stichophormis* and the three following genera represent together the subfamily of Stichophormida, or of those multiradiate Stichocyrtida in which the mouth remains open; they may be derived therefore either from the Theophormida by increasing the number of the shell-joints, or from the Stichopilida by the interpolation of new radial ribs between the three primary ribs. *Stichophormis* may have been derived in the former way from *Theophormis*.

Subgenus 1. *Stichophormium*, Haeckel.

*Definition.*—Shell with six prominent longitudinal ribs, which are prolonged into six (sometimes five or seven) divergent free feet over the mouth.

1. *Stichophormis pyramidalis*, n. sp.

Shell slenderly pyramidal, with three annular septa, and six prominent radial ribs, which arise from the collar-septum, and are prolonged on the mouth into six free, divergent, pyramidal feet,

[1] *Stichophormis* = Row-basket; στίχος, φορμίς.

about as long as the shell. Length of the four joints = 2 : 3 : 5 : 8. Cephalis subspherical, with a stout, pyramidal horn of twice the length. Pores regular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·18, basal breadth 0·08. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·05, *d* 0·08.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

2. *Stichophormis lucerna*, n. sp.

Shell slenderly pyramidal, with three annular septa and six prominent radial ribs, which arise from the second stricture, and are prolonged over the mouth into six free, divergent, cylindrical feet, half as long as the shell. Length of the four joints = 1 : 2 : 3 : 15. Cephalis hemispherical, with a prismatic horn of the same length. Pores in the first and second joints very small and scarce, in the third campanulate joint circular, hexagonally framed, in the colossal fourth joint very large, polygonal (each about as large as the third joint).

*Dimensions.*—Length of the shell (with four joints) 0·4, basal breadth 0·2. Length of the single joints *a* 0·02, *b* 0·04, *c* 0·06, *d* 0·3.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Stichophormis cornutella*, n. sp. (Pl. 75, fig. 9).

Shell slenderly conical, with nine annular strictures and six longitudinal divergent ribs, which arise in the middle of the shell (from the sixth or seventh stricture), and are prolonged over the wide mouth into six slender bristle-shaped feet, about half as long as the shell. The bases of the feet are connected by arcades of lattice-work. All ten joints have nearly the same length and regular hexagonal pores (in the first and second joints circular). Cephalis hemispherical, with a very large curved horn, nearly half as long as the shell, and on one side decurrent to the fourth or fifth joint.

*Dimensions.*—Length of the shell (with ten joints) 0·16, of each single joint about 0·016; basal breadth 0·07.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

## Subgenus 2. *Stichophormiscus*, Haeckel.

*Definition.*—Shell with nine prominent radial ribs, which are prolonged over the mouth into nine (sometimes eight or ten) divergent free feet.

4. *Stichophormis novena*, n. sp. (Pl. 79, fig. 9).

Shell slenderly conical, very similar to the preceding, but with eleven annular strictures and nine divergent ribs, which arise from the tenth or eleventh stricture, and are prolonged over the wide mouth into nine bristle-shaped feet, half as long as the shell. The length of the twelve joints increases gradually; the tenth is twice as long as the sixth. Pores regular, circular. Cephalis

hemispherical, with a curved conical horn of twice the length. (In the somewhat mutilated specimen figured, the horn and the nine feet were broken off, but were well preserved in another specimen, found afterwards.)

*Dimensions.*—Length of the shell (with twelve joints) 0·22, eighth joint 0·02, fourth joint 0·01; basal breadth 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

5. *Stichophormis radiata*, n. sp.

Shell slender, conical, with fourteen annular strictures, and nine radial ribs; three primary ribs arise from the third stricture, the other six (secondary) ribs from the ninth stricture; all are prolonged over the mouth into nine slender bristle-shaped feet, about twice as long as one joint. All joints have nearly the same length. Cephalis subspherical, with a straight, conical horn three times the length. Pores regular, hexagonal.

*Dimensions.*—Length of the shell (with fifteen joints) 0·24, of each joint, about 0·016; basal breadth 0·12.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

## Genus 637. *Phormocampe*, n. gen.

*Definition.*—Stichophormida (vel Stichocyrtida multiradiata aperta), with conical or pyramidal shell, without lateral ribs. Mouth dilated, with a corona of terminal feet.

The genus *Phormocampe* may be derived from the preceding *Stichophormis* by loss of the lateral ribs, whilst the terminal feet remain. It bears therefore to the latter the same relation that *Calocyclas* exhibits to *Theophormis* among the Tricyrtida.

### Subgenus 1. *Anthocorys*, Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Shell with three transverse strictures or annular septa, and with four distinct joints.

1. *Phormocampe campanula*, n. sp. (Pl. 77, fig. 13).

*Anthocorys campanula*, Haeckel, 1881, Prodromus et Atlas (*loc. cit.*).

Shell campanulate, with three internal, annular septa. Length of the four joints = 5 : 2 : 8 : 3. Cephalis three-sided, pyramidal, slender, bearing a pyramidal horn of the same length, with three dentate edges. Thorax very small, hemispherical. Third joint very large, campanulate. Fourth joint of the same breadth, but only one-third as long. Pores subregular, circular. Peristome with a coronal of twelve to fifteen conical, divergent feet, as long as the last joint.

[1] *Phormocampe*=Latticed caterpillar; φόρμος, κάμπη.

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·09. Length of the single joints, *a* 0·05, *b* 0·02, *c* 0·08, *d* 0·03.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Phormocampe lamprocyclas*, n. sp..(Pl. **77**, fig. 16).

Shell conical, with three internal annular septa. Length of the four joints = 1 : 1 : 3 : 4. Cephalis subspherical, as large as the thorax, with a stout, pyramidal horn of three times the length, bearing at the apex a spinulate knob. The fourth joint is the broadest, and has large, circular, hexagonally-framed pores, two to three times as broad as the circular pores of the three first joints. Peristome with a double coronal of short, conical, divergent feet, nine on each coronal.

*Dimensions.*—Length of the shell (with four joints) 0·16, breadth 0·11. Length of the single joints, *a* 0·02, *b* 0·02, *c* 0·05, *d* 0·07.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Phormocampe eucalyptra*, n. sp. (Pl. **77**, fig. 14).

Shell flatly conical, somewhat broader than long, with four internal annular septa. The four joints increase gradually in length and breadth. Pores subregular, hexagonal. Cephalis hemispherical, with two small, divergent horns. Peristome with a coronal of thirty to forty short, conical, divergent feet.

*Dimensions.*—Length of the shell 0·14, breadth 0·17. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·04, *d* 0·05.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

5. *Phormocampe metalis*, n. sp.

Shell spiny, with three broad internal annular septa. Three of the four joints are nearly equal in length, each being three times as long as the first. Cephalis subspherical, with a conical horn of twice the length. The second and third joints are together nearly ellipsoidal, and are not separated externally. The fourth joint is separated from them by a deep stricture, one and a half times as broad, and flatly conical. Pores subregular, circular, hexagonally framed. Peristome with a coronal of twenty to thirty strong, conical, divergent feet.

*Dimensions.*—Length of the shell 0·22, basal breadth 0·16. Length of the single joint, *a* 0·02, *b* 0·06, *c* 0·06, *d* 0·08.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

Subgenus 2. *Cyrtocorys*, Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Shell with four or more transverse strictures, and five or more joints.

5. *Phormocampe mitra*, n. sp.

Shell broadly campanulate, conical, about as broad as long, with five internal annular septa. Length of the six joints gradually increasing. Cephalis flat, cap-shaped, with a short, bristle-shaped, conical horn. Pores small and numerous, regular, hexagonal, with thin bars. Peristome with a coronal of forty to fifty divergent, bristle-shaped feet, about as long as the last joint.

*Dimensions.*—Length of the shell (with six joints) 0·16, of the last joint 0·05; breadth 0·18.

*Habitat.*—North Pacific, Station 235 (off Japan), surface.

6. *Phormocampe conus*, n. sp.

Shell slenderly conical, three times as long as broad, with thirteen distinct strictures. Length of the fourteen joints nearly equal. Breadth gradually increasing towards the mouth. Cephalis hemispherical, with a slender, conical, curved horn of three times the length. Pores small and numerous, regular, circular. Peristome with a coronal of twenty to thirty slightly divergent, bristle-shaped feet, twice as long as the last joint.

*Dimensions.*—Length of the shell (with fourteen joints) 0·22, of each joint (on an average) 0·016; basal breadth 0·08.

*Habitat.*—South Pacific, Station 297, surface.

Genus 638. *Artophormis*,[1] Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Stichophormida (vel Stichocyrtida multiradiata aperta) with ovate or spindle-shaped shell, bearing in its wall numerous lateral ribs, which are prolonged into terminal feet. Mouth constricted.

The genus *Artophormis* and the following *Cyrtophormis* differ from the two preceding genera in the ovate form of the shell, which tapers in breadth towards the constricted mouth. It differs from the similar *Alacorys* in the greater number of the shell-joints, this being four or more.

1. *Artophormis horrida*, n. sp. (Pl. 75, fig. 2).

Shell slenderly ovate, spiny, with three deep strictures, twice as long as broad. Length of the four joints = 2 : 5 : 6 : 7. Whole surface covered with strong, conical spines. Six prominent, longitudinal ribs, decurrent from the cephalis to the mouth, are armed with larger spines, which in the upper joints are directed upwards, in the lower downwards. The six ribs are prolonged over the constricted mouth into six stout, conical feet. Cephalis subspherical, with a conical horn and some smaller spines. Pores circular, of very different sizes.

[1] *Artophormis* = Bread-basket; ἄρτος, φορμίς.

*Dimensions.*—Length of the shell (with four joints) 0·2, breadth 0·1. Length of the single joints, *a* 0·02, *b* 0·05, *c* 0·06, *d* 0·07.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

2. *Artophormis costata*, n. sp.

Shell spindle-shaped, rough, with six distinct strictures, three times as long as broad. The length of the seven joints increases gradually; the last joint is twice as long as the fifth. Six prominent, radial ribs arise from the third stricture, and are prolonged into six slender, convergent, conical feet, as long as the sixth joint. Cephalis hemispherical, with a pyramidal horn, of twice the length. Pores regular, circular.

*Dimensions.*—Length of the shell (with seven joints) 0·24, breadth 0·08. Length of the last joint 0·05.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

3. *Artophormis barbadensis*, Haeckel.

*Calocyclas barbadensis*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. xviii. fig. 8.

Shell slenderly ovate, smooth, with three sharp strictures, twice as long as broad. Length of the four joints = 1 : 2 : 3 : 2. Nine prominent longitudinal ribs arise from the third joint, and are prolonged into nine slender, conical, little convergent feet. Cephalis hemispherical, with a conical horn of the same length. Pores subregular, circular, twice as large in the third joint as in the second; the fourth joint bears above a circle of nine very large pores (alternate with the nine ribs), and below two or three circles of smaller pores (eighteen to twenty-seven in the circumference). Mouth somewhat constricted. The figure of Ehrenberg is incomplete, the horn of the cephalis and the nine feet being broken off.

*Dimensions.*—Length of the shell (with four joints) 0·16, breadth 0·08. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·06, *d* 0·04.

*Habitat.*—Fossil in Barbados.

## Genus 639. *Cyrtophormis*,[1] n. gen.

*Definition.*—Stichophormida (vel Stichocyrtida multiradiata aperta) with ovate or spindle-shaped shell, without lateral ribs. Mouth constricted, with a corona of terminal feet.

The genus *Cyrtophormis* may be derived from the preceding *Artophormis* by reduction of the lateral ribs, whilst the terminal feet (as their free prolongations) remain, and form a corona around the mouth. Sometimes also each constriction bears

[1] *Cyrtophormis* = Plaited-basket; κύρτος, φορμίς.

a corona of spines. It corresponds to *Calocyclas* among the Tricyrtida and *Anthocyrtis* among the Dicyrtida.

### Subgenus 1. *Cyrtophormium*, Haeckel.

*Definition.*—Shell with six (sometimes five or seven) feet on the peristome (three perradial alternate with three interradial).

1. *Cyrtophormis armata*, n. sp. (Pl. 78, fig. 17).

Shell spiny, spindle-shaped, with three annular septa. Length of the four joints = 3 : 4 : 5 : 6. The third joint is the broadest, being twice as broad as the constricted mouth. Pores irregular, roundish. Cephalis conical, armed with a bunch of strong, conical spines, and distinguished by double-contoured pores. Peristome with six (sometimes five or seven) triangular, vertical, parallel, or slightly divergent feet.

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·09. Length of the single joints, *a* 0·03, *b* 0·04, *c* 0·05, *d* 0·06.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Cyrtophormis ovata*, n. sp.

Shell rough, ovate, very thick-walled, with three distinct strictures. Length of the four joints = 1 : 1 : 2 : 3. The fourth joint is the broadest, inversely hemispherical, and three times as broad as the constricted mouth. Pores regular, circular, hexagonally framed. Cephalis hemispherical, with a pyramidal horn of the same length. Peristome with a coronal of six short, conical, curved, outwardly convex teeth.

*Dimensions.*—Length of the shell (with four joints) 0·2, breadth 0·14. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·06, *d* 0·09.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### Subgenus 2. *Cyrtophormiscus*, Haeckel.

*Definition.*—Shell with nine (sometimes eight or ten) feet on the peristome (three perradial alternate with six interradial).

3. *Cyrtophormis cingulata*, n. sp. (Pl. 78, fig. 18).

Shell spiny, spindle-shaped, with three internal annular septa, and three external girdles of spines. The second and third joints are of nearly equal length, twice as broad as the first, and half as broad as the fourth joint. The third joint is the broadest, and twice as broad as the constricted mouth. Pores subregular, circular. Cephalis hemispherical, with a large apical horn, and

a coronal of six strong ascending spines. Peristome beyond the stricture of the mouth somewhat dilated, with nine triangular, divergent teeth (broken off in the specimen figured).

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·09. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·04, *d* 0·08.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

### 4. *Cyrtophormis aculeata*, n. sp.

Shell spiny, slenderly ovate, with five distinct strictures, each with a girdle of spines. The three middle joints are of nearly equal length, each half as long as the second, and one-third as long as the sixth joint. The fifth joint is the broadest, twice as broad as the constricted mouth. Pores regular, circular. Cephalis conical, with a bunch of strong, divergent spines. Peristome with nine strong, conical, vertical, parallel teeth.

*Dimensions.*—Length of the shell (with six joints) 0·18, breadth 0·08. Length of the first joint 0·02, the second 0·04, the three following 0·02, the sixth 0·06.

*Habitat.*—North Pacific; Station 241, depth 2300 fathoms.

### 5. *Cyrtophormis acutata*, Haeckel.

*Eucyrtidium acutatum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 105, Taf. iv. fig. 11.

Shell rough, spindle-shaped, with six annular strictures. The third, fourth, and seventh joints are equal in length, three times as long as the first and the fifth joints. The fourth joint is the broadest, four times as broad as the constricted mouth. Pores irregular, roundish. Cephalis small, subspherical, with a short conical horn. Peristome with nine (?) irregular, triangular, little convergent teeth.

*Dimensions.*—Length of the shell (with seven joints) 0·22, breadth 0·11. Length of the third, fourth, and seventh joints 0·04.

*Habitat.*—Fossil in Tertiary rocks of Sicily; Grotte (Stöhr).

## Subgenus 3. *Acanthocyrtis*, Haeckel.

*Definition.*—Shell with numerous (twelve to twenty or more) terminal feet.

### 6. *Cyrtophormis cylindrica*, n. sp. (Pl. 77, fig. 17).

Shell rough, subcylindrical, with three annular septa. The fourth cylindrical joint is four times as long as the second and the third joints. These three joints are nearly equal in breadth. Pores small and numerous, almost square, in regular, transverse rows; two to three in the first joint, five to six in the second and in the third, fourteen to sixteen in the fourth joint. Cephalis flat, cap-shaped, with a short, pyramidal horn. Peristome half as broad as the shell, hyaline, with a coronal of numerous, very delicate, vertical feet.

*Dimensions.*—Length of the shell (with four joints) 0·2, breadth, 0·08. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·03, *d* 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 7. *Cyrtophormis corona*, n. sp. (Pl. 77, fig. 15).

Shell smooth, conical, ovate, with three deep strictures, about twice as long as broad. The fourth joint is the broadest, inflated, and three times as long as the second and the third joints. Pores small and numerous, circular, in regular, transverse rows; two in the first joint, four in the second and third, and ten in the fourth joint. Cephalis hemispherical, with a stout, pyramidal horn. Peristome two-thirds as broad as the fourth joint, with twelve to fifteen triangular, convergent teeth.

*Dimensions.*—Length of the shell (with four joints) 0·16, breadth 0·08. Length of the single joints, *a* 0·01, *b* 0·03, *c* 0·03, *d* 0·09.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 8. *Cyrtophormis cornuta*, n. sp. (Pl. 77, fig. 18).

Shell thorny, spindle-shaped, with three distinct strictures. Length of the four joints = 2 : 4 : 3 : 5. The third joint is the broadest. Pores circular, of different sizes, in the three first joints double-contoured. Cephalis subspherical, with a large, conical horn of three times the length. The fourth joint is inversely conical, three times as broad as the constricted mouth. Peristome with a coronal of numerous (ten to twenty) irregular, thin, partly forked teeth.

*Dimensions.*—Length of the shell (with four joints) 0·14, breadth 0·07. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·03, *d* 0·05.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### 9. *Cyrtophormis fimbriata*, Haeckel.

*Lithocampe fimbriata*, Stöhr, 1880, Patæontogr., vol. xxvi. p. 103, pl. iv. fig. 3.

Shell rough, spindle-shaped, with six annular septa. The fifth joint is the longest, twice as long as each of the three preceding joints, and four times as long as the sixth. The fourth joint is the broadest, three times as broad as the constricted mouth. Pores small, regular, circular. Cephalis small, subspherical, with a small, conical horn (broken off in the specimen figured). Peristome with an irregular, double coronal of ten to twenty vertical teeth.

*Dimensions.*—Length of the shell (with seven joints) 0·25, breadth 0·1. Length of the fifth joint 0·06, of each of the three preceding 0·03.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; fossil in Sicily (Grotte, Caltanisetta).

### 10. *Cyrtophormis turrita*, n. sp.

Shell smooth, nearly conical, twice as long as broad, with twelve sharp strictures. The thirteen joints increase gradually in length and breadth. The last joint is much longer than any of

the others, twice as long as the eleventh, and twice as broad as the ninth joint. The constricted mouth on its lower surface is only one-third as broad. Cephalis small, hemispherical, with a short, conical horn. Peristome with a coronal of twenty to thirty delicate, partly confluent, vertical teeth.

*Dimensions.*—Length of the shell (with thirteen joints) 0·26, breadth 0·12.

*Habitat.*—South-Eastern Pacific, Station 299 (off Valparaiso), depth 2160 fathoms.

11. *Cyrtophormis turricula*, n. sp. (Pl. 75, fig. 5).

Shell smooth, slender, tower-shaped, with fourteen distinct strictures. The ten first joints are nearly equal in length. The twelfth joint is the largest, three to four times as long as each of the preceding, and broader than all the others, twice as broad as the suddenly constricted mouth. Pores small and numerous, regular, circular, quincuncial. Cephalis small, subspherical, with a pyramidal horn of three times the length. Peristome with a coronal of twenty to thirty very delicate, partly confluent, short, vertical teeth.

*Dimensions.*—Length of the shell (with fifteen joints) 0·3, breadth 0·1. Length of the twelfth joint 0·05.

*Habitat.*—South-Eastern Pacific, Station 298 (off Valparaiso), depth 2225 fathoms.

## Subfamily 2. Stichophænida, Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Phormocampida with the terminal mouth of the shell fenestrated (vel Stichocyrtida multiradiata clausa).

### Genus 640. *Artophæna*,[1] Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Stichophænida (vel Stichocyrtida multiradiata clausa) with six radial ribs or wings.

The genus *Artophæna* and the following genus *Stichophæna* represent together the small subfamily of Stichophænida, or of those Cyrtoidea in which the multiradiate shell is composed of numerous (four or more) joints, and closed at the end by a lattice-plate. The number of the lateral, solid, or latticed appendages is six in *Artophæna*, nine in *Stichophæna*. They may have been derived either from the *Stichophormida* by closure of the terminal mouth, or from the *Stichoperida* by intercalation of three or six interradial appendages.

1. *Artophæna ærostatica*, n. sp. (Pl. 75, fig. 4).

Shell four-jointed, with three sharp strictures and internal septa. The fourth joint is subspherical, longer than the three first joints together, and twice as broad as these. The second joint is

[1] *Artophæna*=Bread-shell; ἄρτος, φαίνω.

twice as long as the first and the third, and armed with six divergent, stout, pyramidal, radial spines or wings of the same length. Cephalis flat, cap-shaped, with an oblique pyramidal horn of twice the length. Pores regular, circular, hexagonally framed.

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·12. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·02, *d* 0·1.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Artophæna senaria*, n. sp.

Shell pear-shaped, with five distinct strictures. Length of the four middle joints little different. The fifth joint is the broadest. From the first stricture there arise six radial ribs, which at the fourth are prominent as six short, conical, divergent spines. The last joint is inversely hemispherical, twice as long as the preceding. Cephalis hemispherical, with a conical horn of the same length. Pores regular, circular.

*Dimensions.*—Length of the shell (with six joints) 0·14, breadth 0·09; of each joint 0·02, of the last 0·04.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

3. *Artophæna hexalatractus*, n. sp.

Shell spindle-shaped, with three sharp strictures, and six triangular, latticed, divergent wings, which arise from the collar stricture and descend along the two middle joints. Their terminal points fall into the same plane as the basal end of the fourth inversely conical joint. Length of the four joints = 1 : 2 : 4 : 2. Cephalis hemispherical, with a conical horn of the same length. (Similar to *Theophæna hexaptera*, Pl. 68, fig. 13, but with three distinct internal annular septa, corresponding to the three external strictures.)

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·08. Length of the four single joints, *a* 0·02, *b* 0·04, *c* 0·08, *d* 0·04.

*Habitat.*—South Pacific (off Juan Fernandez), Station 300, depth 1375 fathoms.

4. *Artophæna hexapodiscus*, n. sp.

Shell ovate, without external strictures, but with five internal annular septa. Length of the six joints = 1 : 2 : 3 : 4 : 3 : 6. Cephalis hemispherical, with a stout conical horn of twice the length. The last joint is the broadest, inversely hemispherical. From the fourth and fifth joints arise six divergent ribs, which are prolonged over the fifth stricture into six triangular, divergent, fenestrated feet, about as long as the last joint. Pores in the upper half of the shell regular, circular, in the lower half irregular, roundish.

*Dimensions.*—Length of the shell (with six joints) 0·2, breadth 0·12. Length of the single joints, *a* 0·015, *b* 0·025, *c* 0·03, *d* 0·04, *e* 0·03, *f* 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

Genus 641. *Stichophæna*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichophænida (vel Stichocyrtida multiradiata clausa) with nine radial ribs or wings.

The genus *Stichophæna* differs from the preceding *Artophæna* in the typical number of the radial lateral appendages, being nine in the former, six in the latter. Usually these are simple ribs enclosed in the shell-wall, more rarely prominent wings.

Subgenus 1. *Stichophænidium*, Haeckel.

*Definition.*—Last joint of the shell rounded, without basal spines.

1. *Stichophæna ritteriana*, n. sp. (Pl. 75, fig. 12).

Shell pear-shaped, twice as long as broad, with seven internal annular septa. The upper half is slenderly conical, composed of seven joints of nearly equal length, gradually increasing in breadth. The lower half is formed only by the eighth joint, which is very large, subglobose, inflated, and as long as the seven other joints together. The spherical cephalis bears a conical horn of the same length. From the thorax arise at equal distances nine radial ribs in the form of thin, triangular lamellæ, which attain their greatest height in the sixth joint, and form nine elegant, denticulate crests in the eighth joint. Pores small and numerous, subregular, circular. This beautiful species is dedicated to my honourable friend, Dr. Paul von Ritter, the magnanimous philanthropist and liberal protector of free science, who founded in the University of Jena the first professorial chair of Darwinism and phylogeny.

*Dimensions.*—Length of the shell (with eight joints) 0·24, breadth 0·12. Length of each of the first seven joints 0·015; diameter of the subspherical last joint 0·12.

*Habitat.*—South Pacific, Station 300 (off Juan Fernandez), depth 1375 fathoms.

2. *Stichophæna darwiniana*, n. sp.

Shell pear-shaped, twice as long as broad, with six distinct strictures. The last joint is the broadest and twice as long as the sixth, three times as long as each of the five preceding joints. The hemispherical cephalis bears a conical horn of twice the length. From the third joint arise nine radial ribs, which reach the sixth joint, but are not developed in the last hemispherical joint. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with seven joints) 0·2, breadth 0·1. Length of five first joints, each 0·018 to 0·022, of the sixth 0·03, of the seventh joint 0·06.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

[1] *Stichophæna* = Row-shell; στίχος, φαίνα.

3. *Stichophæna gœtheana*, n. sp.

Shell ovate, one and a half times as long as broad, rough, with five internal annular septa. The six joints gradually increase in length and breadth. The last joint is the broadest, and half as long as the five others together. The hemispherical cephalis bears a pyramidal horn of twice the length. From the thorax arise nine radial ribs, which attain their greatest height in the fourth joint and reach the fifth joint, but are not developed in the last ovate joint. Pores subregular, circular.

*Dimensions.*—Length of the shell (with six joints) 0·22, breadth 0·14. Length of the single joints, *a* 0·02, *b* 0·025, *c* 0·03, *d* 0·035, *e* 0·04, *f* 0·7.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Subgenus 2. *Stichophænoma*, Haeckel.

*Definition.*—Last joint of the shell pointed, armed with a polar, basal spine, or a bunch of spines.

4. *Stichophæna nonaria*, n. sp. (Pl. 76, fig. 6).

Shell nearly spindle-shaped, with five or six distinct strictures. The third joint is the broadest and longest, and twice as long as the second and the fifth joints. Along the second or third middle joint (beginning from the second or third) descend nine prominent longitudinal ribs. Cephalis hemispherical, with two short, conical, divergent horns. Last joint inversely conical, armed with several strong, conical, divergent spines,

*Dimensions.*—Length of the shell (with seven joints) 0·23, of the third joint 0·05, of the last 0·04; breadth 0·1.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

5. *Stichophæna novena*, n. sp. (Pl. 76, fig. 7).

Shell nearly spindle-shaped, with eight or nine deep strictures. The third joint is the broadest, campanulate, in its lower half with nine prominent ribs, which disappear beyond the third stricture. The following joints are alternately longer and shorter, and decrease gradually in breadth. Thorax hemispherical. Cephalis small, hemispherical, with a conical horn of the same length. Last joint also hemispherical, scarcely larger than the cephalis, with a bunch of conical, divergent spines.

*Dimensions.*—Length of the shell (with nine joints) 0·25, of the third joint 0·05, of the last 0·02; breadth 0·1.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Family LXX. LITHOCAMPIDA, n. fam.

*Artocorida et Artocapsida, Stichocorida et Stichocapsida,* Haeckel, 1881, Prodromus, pp. 437–439.

*Definition.*—Stichocyrtida eradiata. (Cyrtoidea with an annulated shell, divided by three or more transverse constrictions into four or more annular joints, without radial apophyses.)

The family Lithocampida comprises those Cyrtoidea in which the lattice-shell is composed of numerous (four to eight or more) annular joints, and bears no radial apophyses. It may be divided into two subfamilies, differing in the shape of the terminal mouth. This is a simple wide opening in the Stichocorida (and the united Artocorida), closed by a lattice-plate in the Stichocapsida (and the allied Artocapsida). The phylogenetic origin of the Lithocampida may be found in the Theocyrtida.

The number of species of Lithocampida is very great, and amounts here to more than one hundred and sixty, whilst the total number of Stichocyrtida is about two hundred and forty. They represent, therefore, two-thirds of the whole group, whilst one-third is composed of the Podocampida and Phormocampida. Ehrenberg has already described between forty and fifty species in his genera *Eucyrtidium* and *Lithocampe;* the majority of these were fossils from Barbados.

This large number of species may be easily increased by accurate researches on the great masses of Lithocampida, which are found in the Radiolarian ooze of the Challenger, and as fossils in Barbados. The variety in the number, size, and proportion of the shell-joints and of the lattice-pores is very great, and permits us to distinguish a far greater number of species than are here described. Many species are cosmopolitan, and belong to the most common forms of Radiolaria.

This large number of species requires to be disposed in different genera, but the distinction of these latter is a rather difficult task, since the exterior of the shell, as well as its internal structure, offers no striking differences (compare Pls. 78 to 80). In my Monograph (1862, pp. 312 to 319) I have already pointed out the difficulty of distinguishing between *Lithocampe* and *Eucyrtidium.* The general form of the shell exhibits a continuous series of transformations, from a flat, conical, or nearly discoidal form, through cylindrical to ovate, or spindle-shaped shells, the wide open terminal mouth becoming more or less constricted, and finally (in the Stichocapsida) closed. The absence or presence of an apical horn may further serve for the distinction of genera. A peculiar small group is represented by the Spirocampida (*Spirocyrtis, Spirocampe,* Pl. 76, figs. 11 to 17), the transverse latticed girdles separating the single joints, which are usually parallel and horizontal, becoming here partly connected, so that they form a descending spiral.

*Synopsis of the Genera of Lithocampida.*

| | | | | | |
|---|---|---|---|---|---|
| I. Subfamily Stichocorida. Terminal mouth of the last shell-joint a simple wide opening. | All annular septa or transverse strictures of the shell separated, parallel, not connected by a spiral line. | Shell conical or cylindrical. Mouth of the last joint wide open, not distinctly constricted. | Conical, gradually dilated. | With horn, | 642. *Lithostrobus.* |
| | | | | No horn, | 643. *Dictyomitra.* |
| | | | Conical above, cylindrical below. | With horn, | 644. *Stichocorys.* |
| | | | Cylindrical or subcylindrical. | With horn, | 645. *Artostrobus.* |
| | | | | No horn, | 646. *Lithomitra.* |
| | | Shell ovate or spindle-shaped. Mouth of the last joint constricted. | Cephalis with a horn. | Last joint not tubular, | 647. *Eucyrtidium.* |
| | | | | Last joint a long tube, | 648. *Eusyringium.* |
| | | | Cephalis without horn. | Cephalis with tube. | 649. *Siphocampe.* |
| | | | | Cephalis without tube, | 650. *Lithocampe.* |
| | Annular septa or transverse strictures of the shell all or partly obliquely descending and connected spirally. | | | With horn, | 651. *Spirocyrtis.* |
| | | | | No horn, | 652. *Spirocampe.* |
| II. Subfamily Stichocapsida. Terminal mouth closed by a lattice-plate. | Last joint rounded, without a vertical basal spine. | | | With horn, | 653. *Cyrtocapsa.* |
| | | | | No horn, | 654. *Stichocapsa.* |
| | Last joint conical, pointed, with a vertical, basal spine. | | | Cephalis with horn, | 655. *Artocapsa.* |

Subfamily 1. STICHOCORIDA, Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Lithocampida with the terminal mouth of the shell open (vel Stichocyrtida eradiata aperta).

Genus 642. *Lithostrobus*,[1] Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta), with conical shell, gradually dilated towards the wide open mouth. Cephalis with a horn.

The genus *Lithostrobus* is probably the most primitive among the Lithocampida, and comprises those forms of this family in which the slender, conical shell is gradually dilated towards the wide, terminal mouth, each joint being broader than the preceding.

[1] *Lithostrobus* = Cone of silex; λίθος, στρόβος.

It may be derived from *Theoconus* by increase in the number of the joints. Some species are distinguished by a curved axis, which gives them a horn-like appearance; these may be separated as a peculiar genus, *Cornustrobus*.

### Subgenus 1. *Conostrobus*, Haeckel.

*Definition.*—Shell regularly conical, with straight axis; all joints nearly equal in length, gradually increasing in breadth.

#### 1. *Lithostrobus monostichus*, n. sp.

Shell slenderly conical, smooth, with straight axis, and eight to ten deep strictures. All joints nearly of the same length, gradually increasing in breadth; the eighth joint twice as broad as the fourth. In each joint only a single transverse series of small, circular, regular pores. Horn of the cephalis conical, straight, of twice the length. (Similar to *Lithostrobus tetrastichus*, Pl. 80, fig. 6, but in each joint there is only a single series of pores.)

*Dimensions.*—Length of the shell (with ten joints) 0·2, of each joint 0·02; breadth of the fourth joint 0·03, of the eight 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

#### 2. *Lithostrobus distichus*, n. sp.

Shell conical, papillate, with straight axis, and four to six deep strictures. All joints nearly of the same length, the fifth twice as broad as the second. In each joint two transverse rows of large, circular pores. Horn of the cephalis stout, straight, conical, of the same length.

*Dimensions.*—Length of the shell (with six joints) 0·18, of each joint 0·03; breadth of the second joint 0·04, of the fifth 0·08.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

#### 3. *Lithostrobus tristichus*, Haeckel.

*Lithostrobus cuspidatus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.
*Eucyrtidium cuspidatum*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. p. 5, pl. i. fig. 12.

Shell slenderly conical, smooth, with straight axis, and eight to ten deep strictures. All joints nearly of the same length, the eighth joint twice as broad as the third. In each joint three transverse rows of pores. Horn of the cephalis bristle-shaped, strongly curved, about as long as the shell. (Ehrenberg confounds this species with *Lithostrobus cuspidatus*).

*Dimensions.*—Length of the shell (with eight joints) 0·16, of each joint 0·02; breadth of the fourth joint 0·04, of the eighth 0·08.

*Habitat.*—North Pacific, Kamtschatka (Bailey); Station 241, depth 2300 fathoms.

4. *Lithostrobus tetrastichus*, n. sp. (Pl. 80, fig. 6).

Shell slenderly conical, smooth, with straight axis and six to eight deep strictures. All joints nearly of the same length, the eighth joint twice as broad as the second. In each joint four transverse rows of regular, circular pores with very thin bars. Horn of the cephalis conical, strong, curved, about as long as two joints.

*Dimensions.*—Length of the shell (with eight joints) 0·12, of each joint 0·015; breadth of the second joint 0·02, of the eighth 0·04.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

5. *Lithostrobus pentastichus*, n. sp.

Shell slenderly conical, smooth, with straight axis, and six to eight slight strictures. All joints nearly of the same length, the sixth twice as broad as the third. In each joint five transverse rows of small circular pores. Horn of the cephalis pyramidal, of twice the length. (Similar to *Eucyrtidium cienkowskii*, Pl. 80, fig. 9, but regularly conical, with all the joints equal in length.)

*Dimensions.*—Length of the shell (with eight joints) 0·2, of each joint 0·025; breadth of the third joint 0·04, of the sixth 0·08.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

6. *Lithostrobus hexastichus*, n. sp. (Pl. 80, fig. 15).

Shell campanulate-conical, smooth, with straight axis, and six to eight slight strictures. All joints nearly of the same length, the sixth joint twice as broad as the second. In each joint six transverse rows of subregular, hexagonal pores, with thin bars. Horn of the cephalis conical, straight, of about the same length. (The specimen figured is a somewhat irregular one; other specimens found afterwards were perfectly conical and regular, with joints of equal length).

*Dimensions.*—Length of the shell (with six joints) 0·16, of each joint 0·027.

*Habitat.*—Central Pacific, Station 270 to 274, depth 2350 to 2925 fathoms.

## Subgenus 2. *Cornustrobus*, Haeckel.

*Definition.*—Shell horn-shaped, conical, with curved axis; all joints nearly equal in length, gradually increasing in breadth.

7. *Lithostrobus cyrtoceras*, n. sp. (Pl. 80, fig. 2).

Shell horn-shaped, conical, with curved axis, smooth, with six to eight deep strictures. All joints nearly of the same length, gradually increasing in breadth; the sixth joint twice as broad as the second. In each joint about four transverse series of regular circular pores. Horn of the cephalis conical, slightly curved, of the same length.

*Dimensions.*—Length of the curved axis of the shell (with eight joints) 0·24, length of each joint 0·03; breadth of the second joint 0·04, of the sixth 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

8. *Lithostrobus leptoceras*, n. sp.

Shell horn-shaped, slenderly conical, with curved axis (like a quadrant of a circle), smooth, with twelve to fourteen slight strictures. All joints nearly of the same length, the tenth twice as broad as the second. In each joint only a single transverse row of small circular pores. Horn of the cephalis curved, bristle-shaped, half as long as the shell.

*Dimensions.*—Length of the curved axis of the shell (with twelve joints) 0·18, length of each joint 0·15; breadth of the second joint 0·02, of the tenth 0·04.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

9. *Lithostrobus caloceras*, n. sp. (Pl. 80, fig. 4).

Shell horn-shaped, conical, with curved axis, smooth, with six to eight deep strictures. All joints nearly of the same length, the sixth twice as broad as the third. On each joint a single circle of very large roundish pores, separated by two to four series of smaller pores. Horn of the cephalis conical, curved, of twice the length.

*Dimensions*—Length of the curved axis of the shell (with six joints) 0·12, length of each joint 0·02; breadth of the third joint 0·04, of the sixth 0·08.

*Habitat.*—South Pacific, Station 297, depth 1775 fathoms.

10. *Lithostrobus macroceras*, n. sp.

Shell horn-shaped, slenderly conical, with curved, nearly semicircular axis, without external strictures, but with twelve to twenty internal septal rings. All joints nearly of the same length, the twelfth twice as broad as the third. On each joint three to four transverse rows of subregular, small, hexagonal pores. Horn of the cephalis conical, curved, of twice the length.

*Dimensions.*—Length of the curved axis of the shell (with sixteen joints) 0·32, length of each joint 0·02; breadth of the third joint 0·02, of the twelfth 0·04.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

## Subgenus 3. *Cyrtostrobus*, Haeckel.

*Definition*—Shell conical (often more campanulate or irregular), with straight axis; joints of different lengths. Cephalis not lobate.

### 11. *Lithostrobus conulus*, n. sp. (Pl. 80, fig. 1).

Shell slenderly conical, smooth, with straight axis, and seven to ten distinct strictures. Joints of different lengths; the fourth and fifth about twice as long as the preceding and following joints, the former with four to five, the latter with two to three transverse rows of large irregular pores; the seventh joint twice as broad as the third. Horn of the cephalis short, pyramidal.

*Dimensions.*—Length of the shell (with eight joints) 0·14, length of the fifth joint 0·03; breadth 0·06.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 12. *Lithostrobus picus*, Bütschli.

*Lithostrobus picus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.
*Eucyrtidium picus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 1.

Shell slenderly conical, smooth, with straight axis, and six to eight slight strictures. Joints of different lengths, the second twice as long as each of the three following, and four times as long as each of the last joints; the sixth joint one and a-half times as broad as the second. Small circular pores in regular transverse rows; six rows in the first and the second, three rows in the third, fourth, and fifth, a single row in each of the last joints. Horn of the cephalis cylindrical, half as long as the shell.

*Dimensions.*—Length of the shell (with eight joints) 0·12, length of the second joint 0·03; breadth 0·04.

*Habitat.*—Fossil in Barbados.

### 13. *Lithostrobus argus*, Bütschli.

*Lithostrobus argus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.
*Eucyrtidium argus*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. ix. fig. 1.

Shell conical, thorny, with straight axis, and five to seven slight strictures. Joints of different lengths, each of the three first twice as long as each of the following. Pores large, roundish, in transverse rows; three rows in the first and the second joints (which in the figure of Ehrenberg are not separated), two rows in the third joint, a single row in each of the following joints. Horn of the cephalis large, conical, curved, half as long as the shell.

*Dimensions.*—Length of the shell (with seven joints) 0·2, length of the fourth joint (and each following) 0·02; breadth 0·1.

*Habitat.*—Fossil in Barbados.

### 14. *Lithostrobus acuminatus*, Haeckel.

*Eucyrtidium acuminatum*, Bury, 1862, Polycystins of Barbados, pl. i. fig. 1.

Shell slenderly conical, smooth, with straight axis, and four to six deep strictures. Joints gradually increasing in length. Pores in regular, transverse rows, commonly three rows in the first, four

in the second, five in the third, six in the fourth, seven in the fifth, &c. (sometimes the increase of the number is more or less irregular). Horn of the cephalis strong, conical, straight, about as long as the fourth or sixth joint.

*Dimensions.*—Length of the shell (with six joints) 0·2; length of the fourth joint 0·04, breadth 0·06.

*Habitat.*—Fossil in Barbados.

### 15. *Lithostrobus cuspidatus*, Haeckel.

*Eucyrtidium cuspidatum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. ii. fig. 15.

Shell, slender, conical, smooth, with straight axis, and ten to twelve distinct strictures. Joints gradually increasing slightly in length, the tenth twice as long as the third. Pores circular, in regular transverse rows; commonly two rows in the first, three in the second, four in the third, seven in the eighth and following joints. Horn of the cephalis long, bristle-shaped, curved. This species called *Eucyrtidium cuspidatum* by Ehrenberg, differs from *Lithostrobus tristichus* (compare above), to which Bailey had given the same name.

*Dimensions.*—Length of the shell (with ten joints) 0·2; length of the tenth joint 0·03, breadth 0·06.

*Habitat.*—North Atlantic (Greenland, Ehrenberg); Station 348, depth 2450 fathoms.

### 16. *Lithostrobus cornutella*, Bütschli.

*Lithostrobus cornutella*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.
*Eucyrtidium cornutella*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. ii. fig. 14.

Shell slender, conical, smooth, with straight axis, and seven to nine slight strictures. Joints gradually increasing slightly in length, the sixth or seventh about twice as long as the third. Pores circular, in regular transverse rows; two or three in the three or four first joints, three or four in the following, four or five in the last joints. Horn of the cephalis thin, bristle-shaped, curved.

*Dimensions.*—Length of the shell (with eight joints) 0·1; length of the eighth joint 0·01, breadth 0·04.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific; many stations, surface.

### 17. *Lithostrobus tornatus*, Haeckel.

*Eucyrtidium tornatum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 292, Taf. ix. fig. 20.

Shell campanulate-conical, smooth, with straight axis, and four to six deep strictures. Joints broad, gradually increasing in length, the fifth twice as long as the second. Pores small, circular, in regular transverse rows; in the second and third joints three or four rows, in the fifth seven rows, &c. Horn of the cephalis small, double or forked.

*Dimensions.*—Length of the shell (with five joints) 0·1; length of the fifth joint 0·04, breadth 0·08.

*Habitat.*—Indian Ocean, Zanzibar, depth 2200 fathoms (Pullen).

18. *Lithostrobus seriatus*, n. sp. (Pl. 79, fig. 15).

Shell slender, conical, smooth, with straight axis, and four or five deep strictures. Joints little different in length, increasing towards the inflated last joint, which is twice as long as the preceding. On each joint four or five transverse rows of small circular pores. Horn small, bristle-shaped, oblique. This common species is rather variable.

*Dimensions.*—Length of the shell (with five joints) 0·14; length of the fifth joint 0·05, breadth 0·06.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

19. *Lithostrobus cornutus*, n. sp. (Pl. 77, fig. 6).

Shell slender, conical, subcampanulate, smooth, with three or four deep strictures. Joints of different lengths, the third and the fourth twice as long as the second, four times as long as the first. Transverse rows of small circular pores; three in the first joint, five in the second, eight in the third and in the fourth. Horn large, pyramidal, about as long as the third joint.

*Dimensions.*—Length of the shell (with four joints) 0·12; length of the third joint 0·04, breadth 0·06.

*Habitat.*—Central Pacific, Station 265 to 268, depth 2700 to 2900 fathoms.

20. *Lithostrobus microporus*, Bütschli.

*Lithostrobus microporus*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.
*Eucyrtidium microporum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. xi. fig. 20.

Shell slender, conical, smooth, very similar to the preceding species, differs mainly in the more slender form and the smaller pores. The first joint has four, the second eight, the third ten transverse rows of pores. Horn conical, as long as the cephalis. The third joint in this and the preceding species is campanulate, and large.

*Dimensions.*—Length of the shell (with four joints) 0·11; length of the third joint 0·05, breadth 0·04.

*Habitat.*—Fossil in Barbados.

21. *Lithostrobus quadratus*, n. sp.

Shell broad, conical, smooth, with straight axis, and six to eight deep strictures. Joints of different lengths, usually alternately longer and shorter. The seventh joint five times as broad as long, twice as long as the sixth and the fourth; six transverse rows of pores in the seventh, three

in the sixth joint. Horn small, conical. This species differs from all others in the subregular square form of the small pores.

*Dimensions.*—Length of the shell (with seven joints) 0·15.; length of the seventh joint 0·024, breadth 0·12.

*Habitat*—Central Pacific, Station 271 to 274, depth 2350 to 2750 fathoms.

22. *Lithostrobus hexagonalis*, n. sp. (Pl. 79, fig. 20).

Shell broad, conical, smooth, with straight axis, and five to eight prominent girdles between six and nine constricted broad joints. The first and the third joints are half as long as the second, the fourth, and each of the following joints. The sixth joint is five times as broad as long. Pores subregular, hexagonal, in regular transverse rows; three to four rows in the first and the second joints, six to eight in the third, the fourth, and each following joint. Cephalis with some small spines, and a larger, oblique, curved horn.

*Dimensions.*—Length of the shell (with six joints) 0·2; length of the sixth joint 0·04, breadth 0·2.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

## Subgenus 4. *Botryostrobus*, Haeckel.

*Definition.*—Shell conical, with straight axis, joints of different lengths. Cephalis lobate, with some irregular constrictions. (Perhaps derived from Botryodea?).

23. *Lithostrobus botryocyrtis*, n. sp. (Pl. 79, figs. 18, 19).

Shell slender, conical, smooth, with straight axis, and three deep strictures. Joints of different lengths. The length of the fourth joint equals two-thirds of its breadth, and of the length of the three preceding joints together. Each of the latter bears three transverse rows of small, quadrangular pores, the fourth joint has six rows. The cephalis is irregularly lobate, with four to six prominent lobes, and two small divergent horns (fig. 19).

*Dimensions.*—Length of the shell (with four joints) 0·1; length of the fourth joint 0·04, breadth 0·06.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

24. *Lithostrobus lithobotrys*, n. sp. (Pl. 79, fig. 17).

Shell slender, conical, smooth, with straight axis, and four deep strictures. Joints of different lengths, gradually increasing towards the mouth, the length of the fifth joint equals half its breadth, and one-third of the length of the whole shell. The single joints bear each four or five transverse rows of small, roundish pores. Cephalis irregularly lobate, with four to six prominent lobes, and the same number of small, conical horns.

*Dimensions.*—Length of the shell (with five joints) 0·12; length of the fifth joint 0·04, breadth 0·08.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

Genus 643. *Dictyomitra*,[1] Zittel, 1876, Zeitschr. d. deutsch. geol. Gesellsch., p. 80.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta), with conical shell gradually dilated towards the wide open month. Cephalis without horn.

The genus *Dictyomitra* agrees with the preceding *Lithostrobus* in the slender, conical form of the multiarticulate shell, but differs from it in the absence of a horn on the cephalis; the horn is here completely lost.

Subgenus 1. *Dictyomitrella*, Haeckel.

*Definition.*—Shell smooth, with joints nearly equal in length.

1. *Dictyomitra articulata*, Haeckel.

*Eucyrtidium articulatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. figs. 2, 3.

Shell slender, conical, smooth, with six to eight deep strictures. All joints nearly equal in length, gradually increasing in breadth, the eighth four times as broad as long, and twice as broad as the fourth joint. In each joint three to four transverse series of small, regular, circular pores.

*Dimensions.*—Length of the shell (with eight joints) 0·12, of each joint 0·015; breadth of the fourth joint 0·04, of the eighth joint 0·08.

*Habitat.*—Fossil in Barbados.

2. *Dictyomitra macilenta*, Haeckel.

*Eucyrtidium macilentum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. vii. fig. 15.

Shell slender, conical, smooth, with five to seven deep strictures. All joints nearly equal in length, gradually increasing in breadth, the sixth joint three times as broad as long, and twice as broad as the second. In each joint only two transverse series of small, regular, circular pores.

*Dimensions.*—Length of the shell (with seven joints) 0·08, of each joint 0·012; breadth of the sixth joint 0·036, of the second 0·018.

*Habitat.*—Western Tropical Pacific, Stations 200 to 225, in various depths.

[1] *Dictyomitra*=Net-cap; δίκτυον, μίτρα.

3. *Dictyomitra conica*, n. sp.

Shell widely conical, with six to eight prominent strictures. All joints nearly equal in length, gradually increasing in breadth, the eighth five times as broad as long, and twice as broad as the third. In each joint three to four transverse rows of regular, hexagonal pores. (Similar to *Lithostrobus hexagonalis*, Pl. 79, fig. 20, but more slender, and without cephalic horn.)

*Dimensions.*—Length of the shell (with seven joints) 0·16, of each joint 0·022; breadth of the sixth 0·08.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

## Subgenus 2. *Dictyomitrissa*, Haeckel.

*Definition.*—Shell smooth, with joints of very different lengths.

4. *Dictyomitra polypora*, Zittel.

*Dictyomitra polypora*, Zittel, 1876, Zeitschr. d. deutsch. geol. Gesellsch., p. 80, Taf. ii. fig. 1.

Shell slender, conical, rough, with six to nine deep strictures. Breadth and length of the joints gradually increasing, so that the eighth joint is twice as long and broad as the third. Pores regular, circular, in transverse rows, four rows in each joint, in the last joint five to six rows.

*Dimensions.*—Length of the shell (with eight joints) 0·24; length of the eighth joint 0·04, breadth 0·1; length of the third joint 0·02, breadth 0·05.

*Habitat.*—Fossil in secondary rocks of Northern Germany (chalk of Brunswick, &c.), Zittel.

5. *Dictyomitra eurythorax*, n. sp. (Pl. 77, fig. 4).

*Lithocampium eurythorax*, Haeckel, 1881, Prodromus, p. 437, et Atlas, pl. lxxvii. fig. 4.

Shell campanulate, conical, rough, with three deep strictures. Cephalis small, hemispherical. Thorax large, inflated, hemispherical, with six transverse rows of pores. Abdomen with two broader joints, together as long as the thorax, each with three to four rows of pores.

*Dimensions.*—Length of the shell (with four joints) 0·14, of the thorax 0·06; breadth of the thorax 0·08, of the last joint 0·1.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

6. *Dictyomitra microcephala*, Haeckel.

*Eucyrtidium microcephalum*, Ehrenberg, 1858, Monatsber d. k. preuss. Akad. d. Wiss. Berlin, p. 32; Abhandl. d. k. Akad. d. Wiss. Berlin, 1872, p. 291, Taf. xi. fig. 24.

Shell broadly conical, smooth, with six to eight distinct strictures. Breadth of the joints gradually increasing, length unequal. The three first joints short, only one-half or one-third as long as

each of the following joints; in each of the former three to four transverse rows, in each of the latter six to eight transverse rows of small, regular, circular pores.

*Dimensions.*—Length of the shell (with six joints) 0·09, of the three first joints 0·03, of the three following 0·06; breadth of the sixth joint 0·08, of the fourth 0·04.

*Habitat.*—Mediterranean (Candia) Spratt, depth 1620 fathoms.

### 7. *Dictyomitra demersissima*, Haeckel.

*Eucyrtidium demersissimum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. vii. fig. 11.

Shell slender, conical, smooth, with four internal septal rings (without external strictures). Breadth of the five joints gradually increasing, length unequal; the third joint the longest, twice as long as the second, and longer than any of the following. Pores very small and numerous, in longitudinal rows.

*Dimensions.*—Length of the shell (with five joints) 0·09, of the second joint 0·015, of the third 0·03; breadth of the second joint 0·03, of the third 0·05.

*Habitat.*—Tropical Pacific, Philippine Sea, depth 3300 fathoms.

## Subgenus 3. *Dictyomitroma*, Haeckel.

*Definition*—Shell with longitudinal ribs and furrows between them, with joints of different lengths.

### 8. *Dictyomitra costata*, n. sp.

Shell slender, conical, with prominent longitudinal ribs, and six to eight deep strictures. Length of the majority of joints nearly equal, the two or three first joints shorter, the last a little longer. In each joint only a single transverse series of pores at the distal end (one pore in each furrow). (Similar to *Siphocampe tubulosa*, Pl. 79, fig. 13, but conical, and without cephalic tube.)

*Dimensions.*—Length of the shell (with eight joints) 0·16, of each middle joint 0·03, of the first 0·02; breadth of the last joint 0·06.

*Habitat.*—Central Pacific, Station 295, depth 1500 fathoms.

### 9. *Dictyomitra multicostata*, Zittel.

*Dictyomitra multicostata*, Zittel, 1876, Zeitschr. d. deutsch. geol. Gesellsch., p. 81, Taf. ii. figs. 2–4.

Shell slender, conical, with prominent longitudinal ribs, and eight to ten deep strictures. Length and breadth of the joints gradually increasing, the eighth joint twice as long and broad as the fourth joint. Pores regular, circular, one series in each longitudinal furrow, three to four pores on each joint.

*Dimensions.*—Length of the shell (with eight joints) 0·2, of the fourth joint 0·02, of the eighth joint 0·04; breadth of the fourth joint 0·04, of the eighth 0·08.

*Habitat.*—Fossil in secondary rocks of North Germany (chalk of Brunswick, &c.), Zittel.

Genus 644. *Stichocorys*,[1] Haeckel, 1881, Prodromus, p. 438 (*sensu emendato*).

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with a middle constriction of the shell, the upper half of which is conical, the lower cylindrical. Mouth truncate. Cephalis with a horn.

The genus *Stichocorys* is intermediate between the two preceding and the two following genera; the upper half of the shell with the three first joints is conical, the lower half with the fourth and the following joints cylindrical, of equal breadth. The third joint of the shell (or the abdomen of *Theoconus*) is constantly the largest, being broader than all the other joints. *Stichocorys* is a very common and characteristic form, and may be derived from *Theoconus* by development of a post-abdomen.

1. *Stichocorys wolffii*, n. sp. (Pl. 80, fig. 10).

Shell in the upper half (with three joints) thorny, in the lower half (with two joints) smooth. Pores of the former double-contoured, in subregular, transverse rows. Pores of the latter smaller, simple, scarcely scattered. Cephalis with a pyramidal horn of the same length. Thorax with prominent, longitudinal divergent ribs. Dedicated to Caspar Friedrich Wolff (Halle, 1759).

*Dimensions.*—Length of the shell (with five joints) 0·16; breadth of the third joint 0·08, of the fourth 0·05.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Stichocorys panderi*, n. sp. (Pl. 80, fig. 7).

Shell in the upper conical half (with three joints) spiny, in the lower subcylindrical half (with three joints) smooth. Pores small, circular, irregularly scattered, simple. Cephalis with a conical horn of the same length. No longitudinal ribs. Dedicated to Christian Pander (Würzburg, 1817.)

*Dimensions.*—Length of the shell (with six joints) 0·18; breadth of the third joint 0·08, of the fourth 0·05.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Stichocorys baerii*, n. sp. (Pl. 80, fig. 8).

Shell in the upper conical half (with three joints) spiny, in the lower cylindrical half (with three joints) sulcate, with prominent longitudinal ribs, alternating with longitudinal rows of small pores.

[1] *Stichocorys* = Row-helmet; στίχος, κόρυς.

Pores of the upper half smaller, quincuncially disposed. Cephalis with a stout pyramidal horn of the same length. Dedicated to Carl Ernst Baer (Königsberg, 1828).

*Dimensions.*—Length of the shell (with six joints) 0·2; breadth of the third joint 0·09, of the fourth 0·07.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

4. *Stichocorys okenii*, n. sp. (Pl. 80, fig. 5).

Shell smooth, without spines or ribs; the upper conical half (with three joints) about the same length as the lower subcylindrical half (with three joints). Pores subregular, circular, in the inflated third joint twice as large as in the five other joints. At the lumbar stricture (between the second and third joints) a coronal of nine very large pores. Cephalis with a curved horn of half the length. Dedicated to Lorenz Oken (Jena, 1806).

*Dimensions.*—Length of the shell (with six joints) 0·2; breadth of the third joint 0·09, of the fourth 0·07.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

5. *Stichocorys huschkei*, n. sp. (Pl. 80, fig. 3).

Shell in the upper conical half (with three joints) thorny, in the lower cylindrical half (with five joints) smooth, roundish. Pores irregularly scattered, always double-contoured, in the second joint three times as large as in the third. At the third stricture (between the third and fourth joints) a coronal of larger pores. Cephalis with a small, conical horn of half the length. No longitudinal ribs. Dedicated to Emil Huschke (Jena, 1832).

*Dimensions.*—Length of the shell (with eight joints) 0·18; breadth of the third joint 0·08, of the fourth joint 0·07.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

6. *Stichocorys rathkei*, n. sp.

Shell spiny, everywhere covered with short conical spines. The upper conical part of the shell (with three joints) half as long as the lower cylindrical part (with six joints). Pores irregular, roundish, in the thorax twice to three times as large as in the eight other joints. Cephalis with a pyramidal horn of the same length. No longitudinal ribs. Dedicated to Heinrich Rathke (Königsberg, 1839).

*Dimensions.*—Length of the shell (with nine joints) 0·24; breadth of the third joint 0·08, of the fourth joint 0·06.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

7. *Stichocorys mülleri*, n. sp.

Shell in the upper conical part (with three joints) spiny, in the lower cylindrical part (with seven joints) smooth. Pores in the former irregularly scattered, roundish, in the latter circular,

regularly disposed in longitudinal series, alternate, with prominent ribs. The upper conical part of the shell is about half as long as the lower cylindrical part. Cephalis with a large, pyramidal horn of three times the length. Dedicated to Johannes Müller (Berlin, 1858).

*Dimensions.*—Length of the shell (with ten joints) 0·22; breadth of the third joint 0·09, of the fourth joint 0·06.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

## Genus 645. *Artostrobus*, n. gen.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with cylindrical shell, the upper pole of which is rounded, the lower truncate. Cephalis with a horn.

The genus *Artostrobus* and the following *Dictyomitra* differ from all the other Stichocorida in the cylindrical or nearly cylindrical form of the shell, all the joints of which are nearly equal in breadth, and are very short, often with a single transverse row of pores only. The first joint or cephalis is usually different from the following, often hemispherical or cap-shaped joints. The last joint is truncate, and has a wide open mouth. Since the constrictions between the single joints are often very slight, some species are very similar to the Dicyrtide *Sethocorys*.

### Subgenus 1. *Artostrobulus*, Haeckel.

*Definition.*—A single transverse row of small, circular pores on each joint. (Sometimes on the uppermost joints two or three rows.)

1. *Artostrobus annulatus*, Haeckel.

*Cornutella annulata*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. pl. i. fig. 5*a*, 5*b*.
*Eucyrtidium annulatum*, Haeckel, 1862, Monogr. d. Radiol., p. 327.

Shell slender, cylindrical, smooth, without external strictures, but with ten to twenty internal annular septa. On each joint only a single transverse row of small pores. Cephalis hemispherical, with a single or double small horn. Each joint about four times as broad as long.

*Dimensions.*—Length of the shell (with twenty joints) 0·2; length of each joint 0·01, breadth 0·04.

*Habitat.*—Arctic Ocean, Kamtschatka (Bailey); Greenland (Ehrenberg).

[1] *Artostrobus*=Bread-cone; ἄρτος, στρόβος.

2. *Artostrobus elegans*, Haeckel.

? *Eucyrtidium elegans*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, pl. xi. fig. 12.
? *Eucyrtidium pauperum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, pl. xi. fig. 13.

Shell cylindrical, smooth, with eight to ten internal annular septa. Cephalis subspherical, with a short, conical horn. Thorax campanulate, with two transverse rows of pores. Abdomen with six to eight equal joints, each with a single row of pores. (May be described, perhaps, better as *Theocyrtis elegans*. *Eucyrtidium pauperum*, Ehrenberg, *loc. cit.*, may be a variety of this species.)

*Dimensions.*—Length of the shell (with nine joints) 0·1; length of each abdominal joint 0·01, breadth 0·03.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Artostrobium*, Haeckel.

*Definition.*—All (or the majority) of the joints of the shell with several transverse rows of pores, in variable number.

3. *Artostrobus auritus*, Haeckel.

*Lithocampe aurita*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 84.
*Lithocampe auricula*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 71.
*Eucyrtidium auritum*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 25.
*Eucyrtidium auritum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 104, Taf. iv. fig. 7.

Shell subcylindrical, with five sharp strictures. All six joints nearly equal in length; each with four or five transverse rows of small pores. Cephalis small, flat, hemispherical, with two or three small, conical, oblique horns. Mouth of the sixth joint a little constricted.

*Dimensions.*—Length of the shell (with six joints) 0·12; length of each joint (on an average) 0·02, breadth 0·04 to 0·05.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte, Caltanisetta).

4. *Artostrobus biseriatus*, n. sp.

Shell cylindrical, smooth, with ten to twelve deep strictures. All joints nearly equal in size; each with two transverse rows of small circular pores. Cephalis hemispherical, with a long, bristle-shaped, curved horn.

*Dimensions.*—Length of the shell (with twelve joints) 0·24; length of each joint 0·02, breadth 0·04.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

5. *Artostrobus articulatus*, n. sp. (Pl. 79, fig. 16).

Shell subcylindrical, with elegant longitudinal ribs and five sharp strictures. All six joints nearly equal in length, each with three or four transverse rows of small circular pores. The middle joints twice as broad as long. Cephalis hemispherical, with a conical, oblique horn.

*Dimensions.*—Length of the shell (with six joints) 0·16; length of a single joint 0·02 to 0·03, breadth 0·04 to 0·05.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

## Genus 646. *Lithomitra*,[1] Bütschli, 1882, Zeitschr. f. wiss. Zool., p. 529.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with cylindrical shell, the upper pole of which is rounded, the lower truncate. Cephalis without horn.

The genus *Lithomitra* differs from the preceding genus *Artostrobus* in the absence of a cephalic horn, and therefore bears to it the same relation as *Dictyomitra* does to *Lithostrobus*. In many species the joints are very short, and bear only a single transverse row of pores, and since the constrictions between the joints are often very slight, *Lithomitra* becomes very similar to the Dicyrtide *Dictyocephalus*.

### Subgenus 1. *Lithomitrella*, Haeckel.

*Definition.*—A single transverse row of small circular pores on each joint. (Sometimes on the uppermost joints two or three rows.)

1. *Lithomitra pachyderma*, Bütschli.

*Lithomitra pachyderma*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.
*Eucyrtidium pachyderma*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 21.
*Eucyrtidium imbricatum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. xi. fig. 22.

Shell thick-walled, subcylindrical, with longitudinal ribs, slightly dilated in the middle, with ten to twelve subequal joints. On the lower edge of each joint a single row of small circular pores. No external strictures. This and the following species (though separated by Ehrenberg as four different species) may be united.

*Dimensions.*—Length of the shell (with ten joints) 0·11; length of each joint 0·01 to 0·012, breadth 0·04.

*Habitat.*—Fossil in Barbados.

[1] *Lithomitra*=Stone-cap; λίθος, μίτρα.

2. *Lithomitra acephala*, Bütschli.

*Lithomitra acephala*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 529.
*Eucyrtidium acephalum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 5.
*Eucyrtidium obstipum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. xi. fig. 17.

Shell nearly cylindrical, smooth, thick-walled, with twelve to sixteen subequal joints. On each joint a single row of small circular pores. No external strictures. Scarcely differing from the preceding species; the joints are broader and shorter, the cephalis is larger (by union of some joints ?), and the ribs of the surface less distinct.

*Dimensions.*—Length of the shell (with twelve joints) 0·1; length of each joint 0·006 to 0·009, breadth 0·04.

*Habitat.*—Fossil in Barbados.

3. *Lithomitra lineata*, Haeckel.

*Lithocampe lineata*, Ehrenberg (*partim*), 1838, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 130; Mikrogeol., 1854, Taf. xxii. fig. 26.
*Lithocampe lineata*, Haeckel, 1862, Monogr. d. Radiol., p. 316.
*Eucyrtidium lineatum*, Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 43; Mikrogeol., 1854, Taf. xxxvi. fig. 16; Abhandl. d. k. Akad. d. Wiss. Berlin, 1875, p. 72, Taf. xi. fig. 9.
*Dictyomitra lineata*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 101, Taf. iii. fig. 22.

Shell subcylindrical, smooth, with longitudinal ribs, and four to eight slight transverse strictures. Cephalis small, subspherical, with few small pores. Thorax broader, with two or three transverse rows of pores. Each succeeding (abdominal) joint with a single transverse row of small pores. Variable and nearly related to the two preceding species (compare my Monograph, *loc. cit.*).

*Dimensions.*—Length of the shell (with six to eight joints) 0·06 to 0·08; length of each joint (on an average) 0·01, breadth 0·03.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, in various depths; many stations; fossil in Secondary and Tertiary rocks of many places.

4. *Lithomitra nodosaria*, n. sp. (Pl. 79, fig. 1).

Shell subcylindrical, with longitudinal ribs, and five to eight transverse strictures, and prominent girdles between them. On each girdle (at the lowermost edge of each joint) a single transverse row of circular pores. The three or four uppermost joints are united, and represent a conical cephalis.

*Dimensions.*—Length of the shell (with six joints) 0·1; length of each joint 0·01 to 0·15, breadth 0·04 to 0·05.

*Habitat.*—Central Pacific, Station 263 to 274, depth 2350 to 2925 fathoms.

5. *Lithomitra eruca*, n. sp. (Pl. 79, fig. 3).

Shell subcylindrical, diminishing slightly towards both ends, with ten to fifteen slight strictures. On each joint a single transverse row of circular pores, descending obliquely in the wall. The two or three first joints form together a roundish cephalis. Usually each joint is three times as broad as long.

*Dimensions.*—Length of the shell (with twelve joints) 0·2; length of each joint (on an average) 0·016, breadth 0·05.

*Habitat.*—Central Pacific, Station 265 to 268, depth 2700 to 2900 fathoms; fossil in Barbados.

6. *Lithomitra chrysalis*, n. sp. (Pl. 79, fig. 4).

Shell subcylindrical, diminishing slightly towards both ends, with elegant longitudinal ribs, and with five to eight slight strictures. Each of the upper joints with two (or sometimes three) transverse rows of small pores; each of the lower joints with only a single row.

*Dimensions.*—Length of the shell (with six joints) 0·11; length of each joint 0·01 to 0·015, breadth 0·04 to 0·05.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Subgenus 2. *Lithomitrissa*, Haeckel.

*Definition.*—All (or the majority) of the joints of the shell with several tranverse rows of pores, in variable number.

7. *Lithomitra cylindrica*, n. sp.

Shell cylindrical, smooth, with twelve to sixteen internal septal rings (without external strictures). On each joint two transverse rows of small, regular, circular pores. The hemispherical cephalis also has two rows of pores. Each joint is twice as broad as long.

*Dimensions.*—Length of the shell (with sixteen joints) 0·3; length of each joint 0·02, breadth 0·04.

*Habitat.*—South Pacific, Station 297, depth 1775 fathoms.

8. *Lithomitra costata*, Haeckel.

*Dictyomitra costata*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 101, Taf. iii. fig. 23.

Shell with longitudinal ribs, in the upper half conical, in the lower half cylindrical, with six to eight slight strictures. Small, circular pores in regular transverse rows; three rows in each upper joint, two rows in each lower joint (the last joints sometimes confluent).

*Dimensions.*—Length of the shell (with eight joints) 0·15; length of each joint 0·017 to 0·023, breadth 0·04 to 0·05.

*Habitat.*—Fossil in Tertiary rocks of Sicily; Grotte (Stöhr), Caltanisetta (Haeckel).

### 9. *Lithomitra punctata*, Haeckel.

*Lithocampe punctata*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 84.
*Eucyrtidium punctatum*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 24.
*Dictyomitra punctata*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 101, Taf. iii. fig. 24.

Shell subcylindrical, smooth, with four to six distinct strictures. Cephalis small, subspherical. Thorax campanulate-conical. Abdomen cylindrical, with three to four equal joints. In each joint five to six transverse rows of small, circular pores, quincuncially disposed.

*Dimensions.*—Length of the shell (with five joints) 0·1; length of each joint (except the first) 0·02, breadth 0·05.

*Habitat.*—Fossil in Tertiary rocks of Sicily; Caltanisetta (Ehrenberg), Grotte (Stöhr).

### 10. *Lithomitra seriolata*, Haeckel.

*Eucyrtidium seriolatum*, Ehrenberg, 1858, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 33.
*Lithocampe seriolata*, Haeckel, Monogr. d. Radiol., p. 316.

Shell subcylindrical, smooth, with four to six sharp strictures. Cephalis small, hemispherical. Thorax conical. Abdomen cylindrical, with three to five different joints of alternate sizes. Small circular pores in transverse rows; three or four rows in the third and fifth joints, seven or eight rows in the second, fourth, and sixth joints.

*Dimensions.*—Length of the shell (with six joints) 0·1; length of the second and fourth joints 0·03, of the third and fifth joints 0·015.

*Habitat.*—Mediterranean, Crete (Ehrenberg), Corfu (Haeckel).

### 11. *Lithomitra hyperborea*, Haeckel.

*Eucyrtidium hyperboreum*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii., pl. i. fig. 10.
*Lithocampe hyperborea*, Haeckel, 1862, Monogr. d. Radiol., p. 315.

Shell cylindrical, with prominent longitudinal ribs and six deep strictures. Cephalis hemispherical. On each joint three to four transverse rows of small, obsolete pores. Each joint is about twice as broad as long.

*Dimensions.*—Length of the shell (with six joints) 0·12; length of each joint 0·02, breadth 0·04.

*Habitat.*—Arctic and Northern Pacific, Kamtschatka (Bailey).

12. *Lithomitra australis*, Haeckel.

*Lithocampe australis*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 187.
*Lithocampe australis*, Haeckel, 1862, Monogr. d. Radiol., p. 315.
*Eucyrtidium australe*, Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 43; Mikrogeol., 1854, Taf. xxxv., A 21, fig. 18.

Shell subcylindrical, smooth, with five deep strictures. The two middle joints somewhat larger than the two proximal and the two distal joints. Pores small, circular, in regular, transverse rows; two rows in the first and the sixth joints, five rows in the second and the fifth, seven or eight rows in the third and fourth joints. The two latter are twice as broad as long.

*Dimensions.*—Length of the shell (with six joints) 0·14; length of the four smaller joints 0·017, of the two larger joints 0·035; breadth 0·06.

*Habitat.*—Antarctic Sea (lat. 78° 10′ S., long. 162° W.) Ross.

13. *Lithomitra eminens*, Haeckel.

*Lithocampe eminens*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 102, Taf. iv. fig. 2.

Shell subcylindrical, rough, with seven slight strictures. The two or three middle joints half as long as the two preceding and the two following joints. Cephalis small, subspherical. Pores small, in subregular, transverse rows, on the fifth and sixth joints only two rows, on the second, third, seventh, and eighth joints four to five rows.

*Dimensions.*—Length of the shell (with eight joints) 0·27; length of the fifth and sixth joints 0·17, of the others 0·03 to 0·04; breadth 0·08.

*Habitat.*—Fossil in Tertiary rocks of Sicily, Grotte (Stöhr).

14. *Lithomitra infundibulum*, n. sp. (Pl. 79, fig. 5).

Shell in the upper half subconical, in the lower half subcylindrical, rough, with four slight strictures. Cephalis hemispherical. Thorax conical. Abdomen subcylindrical, three-jointed. Pores of the second, third, and fourth joints funnel-shaped, with very small inner, and larger double-contoured outer aperture; on the thorax twelve transverse rows, on the third and fourth joints five rows. Fifth joint with irregular, polygonal pores.

*Dimensions.*—Length of the shell (with five joints) 0·2; length of the thorax 0·06, breadth 0·08; length of each abdominal joint 0·04, breadth 0·08.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 647. *Eucyrtidium*,[1] Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 54.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with ovate or spindle-shaped shell, the mouth of which is constricted, but not prolonged into a tube. Cephalis with a solid horn.

[1] *Eucyrtidium* = Nice small basket; εὖ, κυρτίδιον.

The genus *Eucyrtidium* (as here stated in the definition) and the three following nearly allied genera differ from the preceding Stichocorida in the more or less constricted mouth, and the consequent ovate or spindle-form of the multiarticulate shell. The middle joints of the latter are broader than the upper and the lower joints. In the earlier definition given in my Monograph (1862, pp. 312 to 320), the genus had a much wider sense; but the very large number of species since detected requires a more strict definition. Ehrenberg confounded in his genus *Eucyrtidium* a large number of very different Cyrtoidea. In his last works (1872, 1875) he described not less than one hundred and eleven species, fifty-five fossil and fifty-six living (eight fossil species being yet living). But, in reality, these one hundred and three species belong to twenty or twenty-two very different genera of Cyrtoidea.

Subgenus 1. *Eucyrtis*, Haeckel, 1881, Prodromus, p. 438.

*Definition.*—All joints of the shell nearly of the same length (excepting often the first). Surface smooth or rough, without spines.

1. *Eucyrtidium acuminatum*, Ehrenberg.

*Eucyrtidium acuminatum*, Ehrenberg, 1847, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 43; Mikrogeol, 1854, Taf. xxii. fig. 27.
*Eucyrtidium acuminatum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 104, Taf. iv. fig. 6.
*Eucyrtidium acuminatum*, Haeckel, 1862, Monogr. d. Radiol., p. 326.
*Lithocampe acuminata*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 84.

Shell smooth, slender, nearly spindle-shaped, without external strictures, but with eight to nine internal septal rings. All joints (except the first) nearly of the same length (or the upper somewhat longer). The fifth joint is the broadest. Cephalis small, subspherical, with a short, conical horn. Pores very small and numerous, regular, hexagonal, four to six on the length of each joint.

*Dimensions.*—Length of the shell (with eight joints) 0·14; length of each joint about 0·02; greatest breadth, in the fifth joint, 0·07.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Caltanisetta, Grotte, &c.).

2. *Eucyrtidium tropezianum*, Haeckel.

*Lithocampe tropeziana*, J. Müller, 1858, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 42, Taf. vii. figs. 4, 5, 6.
*Lithocampe tropeziana*, Haeckel, 1862, Monogr. d. Radiol., p. 326.

Shell smooth, slender, nearly spindle-shaped, without external strictures, but with seven or eight internal septal rings. All joints of the same length. The fifth and sixth joints are the broadest. Cephalis hemispherical, with a pyramidal horn of the same length. Pores very small and numerous, regular, circular, hexagonally framed, five to six in the length of each joint. (Very near to the preceding species, but more regular, and with different pores.)

*Dimensions.*—Length of the shell (with eight joints) 0·16, length of each joint 0·02; greatest breadth (in the fifth joint) 0·07.

*Habitat.*—Mediterranean, French shore, St. Tropez (J. Müller), surface.

3. *Eucyrtidium hexagonatum*, n. sp. (Pl. 80, fig. 11).

Shell smooth, ovate, with six to seven internal septal rings. All joints (except the first) nearly of the same length; the sixth joint is the broadest. The seventh and eighth joints (broken off in the specimen figured) gradually decrease toward the constricted mouth, which is as broad as the septum between the third and fourth joints. Cephalis and thorax together pear-shaped, with circular pores, sharp lumbar stricture, and a stout, pyramidal horn of the same length. The five or six abdominal joints with regular, hexagonal pores, six or seven in course of the length of each joint.

*Dimensions.*—Length of the shell (with eight joints) 0·2, length of each joint 0·025 to 0·03; greatest breadth (in the sixth joint) 0·1.

*Habitat.*—Central Pacific, Stations 266 to 272, depth 2425 to 2925 fathoms.

4. *Eucyrtidium fusiforme*, n. sp.

Shell smooth, slender, spindle-shaped, without external strictures, but with ten to twelve internal septal rings. All joints of the same length; the sixth joint is the broadest. Cephalis conical, with a pyramidal horn of the same length. Pores regular, circular, four or five in course of the length of each joint. (Differs from all other species of the genus in the regular, slender, spindle form; the constricted mouth of the last joint is half as broad as the sixth joint.)

*Dimensions.*—Length of the shell (with twelve joints) 0·24, length of each joint 0·02; greatest breadth (on the sixth joint) 0·06, of the mouth 0·03.

*Habitat.*—Indian Ocean, Maldive Islands (Haeckel, 1882), surface.

5. *Eucyrtidium doliolum*, n. sp.

Shell smooth, barrel-shaped, or nearly spindle-shaped, with eight or nine distinct strictures. All joints (except the first) of the same length; the fourth joint is the broadest. Cephalis small, subspherical, with two short, divergent, conical horns. Pores regular, circular, hexagonally framed, three to four in course of the length of each joint.

*Dimensions.*—Length of the shell (with ten joints) 0·2, length of each joint 0·022; greatest breadth (in the fourth joint) 0·08.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

Subgenus 2. *Stichocyrtis*, Haeckel, 1881, Prodromus, p. 438.

*Definition.*—All joints of the shell nearly of the same length (excepting often the first). Surface spiny.

6. *Eucyrtidium spinosum*, n. sp.

Shell spiny, slender, ovate, without external strictures, but with seven or eight internal septal rings. Conical spines of different lengths are scattered over the whole surface. All joints have nearly the same length; the sixth is the broadest. Cephalis conical, with one large and two or three smaller conical horns. Mouth constricted, half as broad as the shell. Pores irregular, roundish, double-edged, three to four on the length of each joint.

*Dimensions.*—Length of the shell (with eight joints) 0·16, length of each joint 0·02; greatest breadth (on the sixth joint) 0·06.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

7. *Eucyrtidium chrysalidium*, n. sp.

Shell spiny, spindle-shaped, with four to five slight strictures, above each stricture a circle or girdle of conical spines (as in the similar *Cyrtophormis cingulata*, Pl. 78, fig. 18). All joints (except the first) have the same length. Cephalis subspherical, with a bunch of divergent spines. Mouth constricted, only one-third as broad as the third joint, which is the broadest. Pores subregular, circular, four to five on the length of each joint.

*Dimensions.*—Length of the shell (with six joints) 0·18, length of each joint 0·032; greatest breadth 0·08.

*Habitat.*—South Pacific, Station 302, depth 1450 fathoms.

## Subgenus 3. *Artocyrtis*, Haeckel.

*Definition.*—Joints of the shell of very different lengths. Surface smooth or rough, without spines.

8. *Eucyrtidium profundissimum*, Ehrenberg.

*Eucyrtidium profundissimum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. vii. fig. 12.

Shell smooth, campanulate, ovate, with three internal septal rings. Four joints of different lengths. Cephalis subspherical, with a small bristle-shaped horn. Thorax campanulate, nearly twice as long as each of the two following joints, which are nearly equal in breadth. Terminal mouth wide open, little constricted. Pores very small and numerous, regular, hexagonal.

*Dimensions.*—Length of the shell (with four joints) 0·12; length of the thorax 0·05, breadth 0·07.

*Habitat*—Pacific; many Stations (Stations 206, 225, 253, 265, &c.), in depths between 2000 and 4000 fathoms.

9. *Eucyrtidium anthophorum*, Haeckel.

*Thyrsocyrtis anthophora*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 84, Taf. xii. fig. 9.

Shell smooth, slender, ovate, with three slight strictures. Four joints of different lengths. Cephalis subspherical, with a stout, club-shaped, spinulate or branched horn of the same length. Second campanulate and third subcylindrical joint about equal in size. Fourth joint only half as long, with slightly constricted mouth (broken off in Ehrenberg's figure). Pores small and numerous, regular, circular, quincuncial.

*Dimensions.*—Length of the shell (with four joints) 0·12; length of the second and of the third joints 0·04, breadth 0·05 to 0·06.

*Habitat.*—Fossil in Barbados.

10. *Eucyrtidium hertwigii*, n. sp. (Pl. 80, fig. 12).

Shell smooth, ovate, truncate, with three distinct strictures. Four joints of different lengths. Cephalis campanulate, with an internal rod-cross, and a stout pyramidal horn of the same length. Second joint campanulate. Third joint larger, subcylindrical, with a variable number of irregular, longitudinal ribs, some of which are prolonged into the second and fourth joints. The latter is only half as long, and slightly constricted towards the mouth. Pores small and numerous, subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·22. Length of the single joints, *a* 0·03, *b* 0·06, *c* 0·08, *d* 0·05; breadth, *a* 0·03, *b* 0·1, *c* 0·12, *d* 0·11.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

11. *Eucyrtidium lagena*, Haeckel.

*Eucyrtidium lagena*, Haeckel, 1862, Monogr. d. Radiol., p. 325, Taf. iv. fig. 11.
*Lithocampe lagena*, Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 839.

Shell smooth, bottle-shaped, with three distinct strictures. Four joints of different sizes. Cephalis small, spherical, with a bristle-shaped horn of the same length. Second joint conical, third subcylindrical, fourth inflated, with slightly constricted mouth; their lengths about equal. Pores subregular, hexagonal, large, with thin bars.

*Dimensions.*—Length of the shell (with four joints) 0·16; length of each of the three lower joints about 0·05, breadth 0·05 to 0·064.

*Habitat.*—Mediterranean (Messina).

12. *Eucyrtidium teuscheri*, n. sp. (Pl. 77, fig. 5).

Shell smooth, bottle-shaped, with three distinct strictures. Four joints of different lengths. The third joint four times as long as each of the two first joints, and longer than the fourth, which

is little constricted towards the mouth. The greatest breadth is in the middle of the shell. Cephalis hemispherical, with a small, conical horn of the same length. Pores large, circular, of variable sizes. Dedicated to Dr. Reinhold Teuscher.

*Dimensions.*—Length of the shell (with four joints) 0·16. Length of the single joints, *a* 0·015, *b* 0·02, *c* 0·07, *d* 0·055; breadth, *a* 0·03, *b* 0·05, *c* 0·08, *d* 0·06.

*Habitat.*—Central Pacific, Stations 266 to 274, depth 2350 to 2925 fathoms.

### 13. *Eucyrtidium bütschlii*, n. sp. (Pl. 77, fig. 7).

Shell rough, slender, ovate, truncate, with three distinct strictures. Four joints of different lengths; the third is the largest, inflated, subspherical. Fourth joint subcylindrical, little constricted towards the truncate mouth. Cephalis hemispherical, with a small, conical horn. Pores circular, much larger in the third joint than in the three others.

*Dimensions.*—Length of the shell (with four joints) 0·16. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·06, *d* 0·05; breadth, *a* 0·03, *b* 0·07, *c* 0·09, *d* 0·07.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 14. *Eucyrtidium galatheæ*, Ehrenberg.

*Eucyrtidium galatheæ*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 242.

Shell smooth, campanulate, with three deep strictures. Four joints of different lengths; the fourth joint is the broadest, twice as long as the third and the second, three times as long as the hemispherical cephalis, which bears a stout, pyramidal, oblique horn of twice the length. Mouth little constricted. Pores regular, circular, in transverse rows, three rows in each of the three first joints, five or six rows in the last joint.

*Dimensions.*—Length of the shell (with four joints) 0·12; length of the fourth joint 0·05, breadth 0·07.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

### 15. *Eucyrtidium galea*, Haeckel.

*Eucyrtidium galea*, Haeckel, 1862, Monogr. d. Radiol., p. 324, Taf. vii. figs. 8–10.
*Lithocampe galea*, Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 838.

Shell smooth, helmet-shaped, with four sharp strictures. Five joints of different lengths. Cephalis small, spherical, with a thin pyramidal horn of the same length. Second joint conical, about as long as the third, longer than the fourth and the fifth joints. The third joint is the broadest. Pores regular, circular, small and numerous.

*Dimensions.*—Length of the shell (with five joints) 0·18; length of the second and the third joints 0·05, of the fourth 0·03; breadth 0·08 to 0·1.

*Habitat.*—Mediterranean (Messina), surface.

16. *Eucyrtidium eruca*, Ehrenberg.

*Eucyrtidium eruca*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. x. fig. 13.

Shell smooth, slender, ovate, or nearly spindle-shaped, with four sharp strictures. Five joints of different lengths, the third and fourth nearly equal, twice as long as the fifth, one and a half times as long as the second; the fourth joint is the broadest. Mouth little constricted. Cephalis subspherical, with a small, conical horn. Pores small and numerous, subregular, circular.

*Dimensions.*—Length of the shell (with five joints) 0·12 to 0·14; length of the third and the fourth joints, 0·03 to 0·04, breadth 0·04 to 0·05.

*Habitat.*—Cosmopolitan; Atlantic, Pacific, in different depths; also fossil in Barbados and Sicily.

17. *Eucyrtidium montiparum*, Ehrenberg.

*Eucyrtidium montiparum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. ix. fig. 11.

Shell rough, nearly spindle-shaped, with five deep strictures. Six joints of different lengths, the third and fourth nearly equal, longer than the fifth and the sixth joints; the fourth joint is the broadest. Mouth slightly constricted. Cephalis very small, hemispherical, hyaline, with a short, conical horn. Pores subregular, circular, twice as broad as in the similar smaller preceding species.

*Dimensions.*—Length of the shell (with six joints) 0·2; length of the third and the fourth joints 0·05, breadth 0·07 to 0·08.

*Habitat.*—Fossil in Barbados.

18. *Eucyrtidium cienkowskii*, n. sp. (Pl. 80, fig. 9).

Shell smooth, subconical, with five distinct strictures. Six joints of different lengths; the third joint conical, one and a half to two times as long as each of the other joints; the fifth joint is the broadest. Mouth wide, very slightly constricted. Cephalis hemispherical, with an oblique pyramidal horn of the same length. Pores regular, circular, in dense transverse rows; five to six rows in each of the three last joints, eight to nine rows in the third joint.

*Dimensions.*—Length of the shell (with six joints) 0·16, length of the third joint 0·04, of each following joint 0·02; greatest breadth (in the fifth joint) 0·08.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

19. *Eucyrtidium elongatum*, Stöhr.

*Eucyrtidium elongatum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 105, Taf. iv. fig. 10.

Shell rough, slender, nearly spindle-shaped, variable in size and form, with six to seven distinct strictures. Seven to eight joints of different lengths, often alternately longer and shorter. The second

and the last joints are the longest, the third is the broadest. Mouth slightly constricted (broken off in Stöhr's figure). Cephalis small, subspherical, with a small, oblique, curved horn. Pores irregular.

*Dimensions.*—Length of the shell (with seven joints) 0·2; length of the single joints, between 0·02 and 0·04, breadth 0·06 to 0·08.

*Habitat.*—Fossil in Sicily (Grotte, Caltanisetta).

### 20. *Eucyrtidium stöhrii*, n. sp.

Shell smooth, spindle-shaped, gradually diminishing towards both ends, with eight to ten distinct strictures. Nine to eleven joints of different lengths; the two or three middle joints—fifth, sixth, and seventh—longer and broader than the other joints; the broadest is the fifth joint, which is twice to three times as long as the first and last joints. Cephalis subspherical, with a conical horn of the same length. Terminal mouth strongly constricted, one-half or one-third as broad as the fifth joint. Pores small, regular, circular.

*Dimensions.*—Length of the shell (with ten joints) 0·22; length of the largest (fifth joint) 0·03, breadth 0·09.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

### 21. *Eucyrtidium scalarium*, n. sp.

Shell smooth, slender, ovate, with nine to ten deep strictures, and ten to eleven separate step-like joints of different lengths. The sixth joint is the longest, twice as long as the fourth, and three times as long as the third and the last joint; the seventh and eighth joints are the broadest, one and a half times as broad as the wide mouth. Cephalis hemispherical, with a short pyramidal horn of the same length. Pores small and numerous, subregular, square, in regular transverse rows; six rows in the sixth joint, three rows in the last joint. (Somewhat similar to *Spirocyrtis scalaris*, Pl. 76, fig. 14, but ovate, not conical and not spiral.)

*Dimensions.*—Length of the shell (with eleven joints) 0·22, breadth 0·11; length of the last joint 0·01, of the sixth 0·03.

*Habitat.*—North Atlantic, Station 64, surface.

## Subgenus 4. *Acanthocyrtis*, Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Joints of the shell of very different lengths. Surface spiny.

### 22. *Eucyrtidium tricinctum*, n. sp. (Pl. 78, fig. 13).

Shell spiny, spindle-shaped, with three distinct strictures. Four joints of different lengths, the first and third half as long as the second and fourth; the third joint is the broadest, four times as

broad as the strongly constricted mouth. Spines irregularly scattered over the lower half of the shell, increasing in size towards the mouth. Pores subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·25. Length of the single joints, *a* 0·03 *b* 0·08, *c* 0·04, *d* 0·09; breadth (of the third joint) 0·1.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 23. *Eucyrtidium armatum*, n. sp. (Pl. 78, fig. 14).

Shell spiny, spindle-shaped, with three distinct strictures. Four joints of different lengths, the second and third joints of the same length, shorter than the fourth joint; the third joint is the broadest, four times as broad as the strongly constricted mouth. The latter, as well as the conical cephalis, is armed with an irregular bunch of strong conical spines, while numerous smaller spines are scattered over the whole surface. Pores irregular, roundish, double-contoured.

*Dimensions.*—Length of the shell (with four joints) 0·2. Length of the single joints, *a* 0·02, *b* 0·05, *c* 0·05, *d* 0·08; breadth (of the third joint) 0·1.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

### 24. *Eucyrtidium conostoma*, n. sp. (Pl. 78, fig. 16).

Shell spiny, spindle-shaped, with four distinct strictures. Five joints of different lengths, having the proportion = 1 : 2 : 3 : 6 : 10. The fourth joint is the broadest, inflated, twice as broad as long. Cephalis small, with a conical horn of the same length. Fifth joint inversely conical, with a narrow mouth, broader than the cephalis. Short conical spines are scattered over the whole surface. Pores subregular, circular.

*Dimensions.*—Length of the shell (with five joints) 0·22. Length of the single joints, *a* 0·01, *b* 0·02, *c* 0·03, *d* 0·06, *e* 0·1; breadth (of the fourth joint) 0·09.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

### 25. *Eucyrtidium ehrenbergii*, n. sp. (Pl. 78, fig. 15).

Shell spiny, spindle-shaped, with four distinct strictures (the first and the fourth are by a mistake not distinctly figured). Five joints of different lengths, having the proportion = 2 : 3 : 4 : 2 : 5. The third joint is the broadest, twice as broad as long, and twice as broad as the constricted mouth. Whole surface covered with strong spines. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with five joints) 0·16. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·04, *d* 0·02, *e* 0·05; breadth (in the third joint) 0·08.

*Habitat.*—Western Tropical Pacific, Station 220, depth 1100 fathoms.

### 26. *Eucyrtidium ovatum*, n. sp.

Shell spiny, inversely ovate, with five sharp strictures. Six joints of different lengths, having the proportion = 1 : 3 : 2 : 1 : 1 : 3. The third joint is the broadest, three times as broad as the con-

stricted mouth. Cephalis with a stout pyramidal horn of the same length. Whole surface spiny. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with six joints) 0·22. Length of the single joints, *a* 0·02, *b* 0·06, *c* 0·04, *d* 0·02, *e* 0·02, *f* 0·06; breadth (in the third joint) 0·11.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Genus 648. *Eusyringium*,[1] Haeckel, 1881, Prodromus, p. 437.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with ovate or spindle-shaped shell, the mouth of which is constricted, and prolonged into a terminal cylindrical tube. Cephalis with a solid horn.

The genus *Eusyringium* differs from the preceding closely allied genus *Eucyrtidium* in the peculiar formation of the last shell-joint, representing a narrow, cylindrical, fenestrated tube. It exhibits, therefore, to the latter the same relation as *Theosyringium* bears to *Theocorys*.

### Subgenus 1. *Eusyringartus*, Haeckel.

*Definition.*—Shell with three strictures and four joints; the third joint is the largest, inflated, and much broader than the three others.

#### 1. *Eusyringium conosiphon*, n. sp. (Pl. 78, fig. 10).

Shell with four joints, very thick-walled, rough. Cephalis hemispherical, with a very stout, smooth, three-sided pyramidal horn of the same length and breadth. Thorax hemispherical. Third joint subspherical, three times as long, and twice as broad as the thorax, and of the same length as the slender, inversely conical fourth joint. Pores in the three first joints subregular, circular, in the fourth joint irregular.

*Dimensions.*—Length of the shell (with four joints) 0·25. Length of the single joint *a* 0·02, *b* 0·03, *c* 0·1, *d* 0·1; breadth 0·12.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

#### 2. *Eusyringium pachysiphon*, n. sp. (Pl. 78, fig. 11).

Shell with four joints, very thick-walled, rough. Cephalis conical, with a thick, dimpled, conical horn of the same length. Thorax hemispherical. Third joint inflated, subspherical, and fourth joint slender, inversely conical, as in the similar preceding species. Differs from the latter

[1] *Eusyringium* = Nice small tube; εὖ, συρίγγιον.

mainly in the form of the cephalic horn, and the cylindrical tube of the last joint. Pores subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·3. Length of the single joints, *a* 0·03, *b* 0·03, *c* 0·12, *d* 0·12; breadth 0·15.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 3. *Eusyringium macrosiphon*, n. sp. (Pl. 78, fig. 12).

Shell with four joints, thick-walled, rough. Cephalis subspherical, with a large, dimpled, conical horn of twice the length. The three following joints nearly of the same shape as in the two similar preceding species. It differs from these in the smaller size, the larger cephalic horn, and the longer tube of the fourth joint, which is twice as long as the subspherical third joint (in the figure the lower half is broken off). Pores subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·3. Length of the single joints, *a* 0·03, *b* 0·03, *c* 0·08, *d* 0·16; breadth 0·09.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

### 4. *Eusyringium leptosiphon*, n. sp.

Shell with four joints, thin-walled, smooth. Cephalis subspherical, with a large, dimpled, slender, conical horn of three times the length. Thorax hemispherical. Third joint ovate, four times as long as the thorax, and of the same length as the thin, cylindrical tube of the fourth joint. Differs from the three preceding species in the more slender form and the thinness of the tube. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with four joints) 0·33. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·13, *d* 0·15; breadth 0·1.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

### 5. *Eusyringium sipho*, Haeckel.

*Eucyrtidium sipho*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 72, Taf. ix. fig. 2.

Shell with four joints, thick-walled, smooth. Cephalis subspherical, hyaline, without pores, with a thick, conical horn of twice the length. Thorax hemispherical. Third joint ovate, four times as long as the thorax, and of the same length as the thin, cylindrical fourth joint. Pores subregular, circular, in the fourth joint twice as broad as in the third, and three times as broad as in the second joint.

*Dimensions.*—Length of the shell (with four joints) 0·22. Length of the single joints, *a* 0·02, *b* 0·02, *c* 0·09, *d* 0·09; breadth 0·08.

*Habitat.*—Fossil in Barbados.

6. *Eusyringium fistuligerum*, Haeckel.

*Eucyrtidium fistuligerum*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 70, Taf. ix. fig. 3.

Shell with four joints, thin-walled, smooth. Cephalis subspherical, with numerous very small pores, and a stout, pyramidal horn of the same length. Thorax hemispherical. Third joint subspherical, four times as long as the thorax, and of the same length as the slender, inversely conical or cylindrical, fourth joint. Pores irregular, roundish or circular, in the fourth joint twice as broad as in the two preceding joints.

*Dimensions.*—Length of the shell (with four joints) 0·2. Length of the single joints, *a* 0·02, *b* 0·02, *c* 0·08, *d* 0·08; breadth 0·09.

*Habitat.*—Fossil in Barbados.

## Subgenus 2. *Eusyringoma*, Haeckel.

*Definition.*—Shell with four or more strictures, and five or more joints; the last joint is strongly constricted, and forms a narrow cylindrical tube.

7. *Eusyringium lagenoides*, Haeckel.

*Eucyrtidium lagenoides*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 104, Taf. iv. fig. 8.

Shell with five joints, and four sharp strictures, nearly spindle-shaped. The third joint is twice as long as the second and the fourth. Cephalis small, cap-shaped, with a thin conical horn of the same length. The fifth joint is in Stöhr's figure broken off, but well conserved in a specimen from Caltanisetta, and represents a slender cylindrical tube, with few pores, half as long as the shell. Pores small, subregular, circular, quincuncial.

*Dimensions*—Length of the shell (with five joints) 0·24, breadth 0·08; length of the third joint 0·06, of the second and the fourth 0·03, of the fifth 0·1; breadth of the basal tube 0·027.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte, Caltanisetta).

8. *Eusyringium rhaphanus*, Haeckel.

*Eucyrtidium rhaphanus*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 106, Taf. iv. fig. 12.

Shell with six or seven joints of very different lengths, in the upper half campanulate, in the lower cylindrical. The second and the two last joints are the longest. Cephalis small, subspherical, with a short conical horn. The last joint is a narrow cylindrical tube of variable length, scarcely one-fourth as broad as the preceding joints. Pores in the upper joints regular, circular, in the lower irregular, roundish.

*Dimensions.*—Length of the shell (with seven joints) 0·2, breadth 0·1; length of the second and last joints 0·03 to 0·04; breadth of the basal tube 0·025.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte).

9. *Eusyringium siphonostoma*, n. sp. (Pl. 80, fig. 14).

Shell with eight joints, in the upper half slender, conical, in the lower half cylindrical. The single joints are separated by seven internal annular septa. The third and the seventh joints are the largest, twice as long as the three intercalated joints. Cephalis small, cap-shaped, with a conical horn of twice the length. The last joint (broken off in the specimen figured) is a narrow cylindrical tube, one-third as long and one-third as broad as the shell. Pores regular, circular, quincuncial.

*Dimensions.*—Length of the shell (with eight joints) 0·24, breadth 0·08; length of the single joints 0·02 to 0·04; breadth of the basal tube 0·03.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

10. *Eusyringium cannostoma*, n. sp. (Pl. 80, fig. 13).

Shell with nine or ten joints, slender ovate. The single joints are separated by eight or nine internal annular septa. The third joint is the longest, about twice or three times as long as each following joint. Cephalis hemispherical, with a curved, conical horn of the same length. The last joint is a narrow, cylindrical tube, about as long as the third joint, but only one-fourth as broad. Pores small, regular, circular, quincuncially disposed, and hexagonally framed.

*Dimensions.*—Length of the shell (with ten joints) 0·22, breadth 0·08; length of the third joint 0·04, of the other joints 0·01 to 0·02, of the basal tube 0·04; breadth of the latter 0·02.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 649. *Siphocampe*,[1] Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with ovate or spindle-shaped shell, the mouth of which is constricted, but not prolonged into a tube. Cephalis with an oblique, open, apical tube.

The genus *Siphocampe* differs from the closely allied genera *Lithocampe* and *Eucyrtidium* in a very remarkable character, viz., the development of a hollow cylindrical tube on the cephalis. This probably serves for the emission of a bunch of pseudopodia. It has the same position and the same oblique direction on the cephalis as the solid apical horn of *Eucyrtidium*

### Subgenus 1. *Siphocampula*, Haeckel.

*Definition.*—All joints of the shell (excepting the first) are nearly equal in length.

[1] *Siphocampe* = Caterpillar with a tube; σιφων, κάμπη.

1. *Siphocampe tubulosa*, n. sp. (Pl. 79, fig. 13).

Shell slender, nearly spindle-shaped, with eight deep transverse strictures, and elegant longitudinal ribs. Nine joints slightly different in length and shape. Cephalis flat, cap-shaped, with three or four transverse rows of small pores, and a cylindrical, oblique tubule of twice the length. Each successive joint with a single transverse row of regular, circular pores at its lower edge, separated by divergent, longitudinal ribs. Last joint shorter, with a hyaline annular peristome of the same length. Mouth half as broad as the middle part of the shell.

*Dimensions.*—Length of the shell (with nine joints) 0·24; length of each joint (on an average) 0·02 to 0·03; breadth 0·08.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Siphocampe annulosa*, n. sp. (Pl. 79, fig. 10).

Shell slender, subcylindrical, with nine slight transverse strictures, and interrupted longitudinal ribs. Ten joints nearly equal in length and shape, excepting the two first, which together form a hemispherical cephalothorax, with six to eight transverse rows of pores. Tubule of the cephalis short and wide, truncate, conical. Each of the eight abdominal joints with a single transverse row of small pores. Mouth constricted, without tubulose peristome, half as broad as the shell.

*Dimensions.*—Length of the shell (with ten joints) 0·18; length of each joint (on an average) 0·02, breadth 0·07.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

3. *Siphocampe camiuosa*, n. sp. (Pl. 79, fig. 12).

Shell slender, subcylindrical, with six deep tranverse strictures. Seven joints nearly equal in length and breadth. Cephalis hemispherical, with an oblique, cylindrical tubule of twice the length (in the figure the greater part is broken away). Small circular pores in transverse rows and in variable number; usually three rows in the first and the last joint, five rows in the fourth joint, four rows in each of the other joints. Mouth constricted, with a short tubulose peristome, only one-third as broad as the shell.

*Dimensions.*—Length of the shell (with seven joints) 0·18; length of each joint (on an average) 0·025, breadth 0·055.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

4. *Siphocampe erucosa*, n. sp. (Pl. 79, fig. 11).

Shell slender, nearly spindle-shaped, with five slight transverse strictures. Six joints nearly equal in length. The two first joints are united, and form together a hemispherical cephalothorax, with a short, oblique, cylindrical tubule. Pores regular, circular, double-contoured, in regular, transverse rows; two rows in the first and the last joints, four rows in each of the four middle joints. Mouth constricted, without peristome, only one-third as broad as the shell.

*Dimensions.*—Length of the shell (with six joints) 0·14; length of each joint (on an average) 0·02, breadth 0·07.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

Subgenus 2. *Siphocampium*, Haeckel, 1881, Prodromus, p. 437.

*Definition.*—The joints of the shell are very different in length.

5. *Siphocampe quadrantalis*, n. sp.

Shell nearly spindle-shaped, with three deep strictures. Four joints of very different lengths. Cephalis subspherical, with an oblique cylindrical tubule of twice the length, and with few small pores. Thorax ovate, half as long as the shell, with twelve transverse rows of small pores. Abdomen with two short joints, each of which has two transverse rows of pores. Mouth constricted, one-third as broad as the thorax.

*Dimensions.*—Length of the shell (with four joints) 0·18; length of the thorax 0·1, breadth 0·08.

*Habitat.*—Western Tropical Pacific; North Coast of New Guinea, Station 220, depth 1100 fathoms.

6. *Siphocampe spiralis*, n. sp. (Pl. 79, fig. 14).

Shell nearly spindle-shaped, with eight slight strictures. Nine joints of very different lengths. Cephalis subspherical, with an oblique cylindrical tubule of the same length, and numerous small pores. Thorax conical, one-fourth as long as the shell, with eight transverse rows of small pores. Abdomen with numerous prominent, spirally convoluted ribs, and spiral rows of pores between them. The first abdominal joint is from two to three times as long as each of the six following joints. Abdominal pores larger, roundish, disposed in eleven transverse rows. Four rows in the first abdominal joint, one row in each of the five following, and two rows in the last joint. Mouth slightly constricted, two-thirds as broad as the shell.

*Dimensions.*—Length of the shell (with nine joints) 0·17, cephalis 0·02, thorax 0·04, abdomen 0·11; breadth 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms; also fossil in Barbados.

Genus 650. *Lithocampe*,[1] Ehrenberg, 1838, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 128 (*sensu emendato*).

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with ovate or spindle-shaped shell, the mouth of which is constricted, but not prolonged into a tube. Cephalis without horn and tube.

[1] *Lithocampe* = Stone-caterpillar; λίθος, κάμπη.

The genus *Lithocampe* is the oldest of all "Polycystina," being founded by Ehrenberg in 1838 upon *Lithocampe radicula*. Afterwards numerous other species, which belong to very different genera, were described by him. In 1862 I attempted to give a more strict definition of this genus in my Monograph (p. 312 to 315), and separated it from the closely allied and often confounded *Eucyrtidium* by the absence of a cephalic horn. The great number of species afterwards discovered leads to the stricter definition given above.

### Subgenus 1. *Lithocampula*, Haeckel.

*Definition.*—All joints of the shell (except often the first) are equal or nearly equal in length.

#### 1. *Lithocampe eupora*, Haeckel.

*Eucyrtidium euporum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 291, Taf. iv. fig. 30.

Shell smooth, ovate or subconical, with three deep strictures. Four joints equal in length, gradually increasing in breadth, each with three transverse rows of regular, circular, hexagonally-framed pores; the fourth joint is the broadest. Mouth little constricted, of the same breadth as the third joint.

*Dimensions.*—Length of the shell (with four joints) 0·08; length of each joint 0·02, greatest breadth 0·06.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms; North Atlantic, depth 3600 fathoms (Morse).

#### 2. *Lithocampe platycephala*, Haeckel.

*Eucyrtidium platycephalum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, pp. 145, 293, Taf. iii. fig. 16.

Shell smooth, subconical or slenderly ovate, with three slight strictures. Four joints equal in length, slightly increasing in breadth towards the mouth. The hemispherical cephalis with longitudinal ribs and irregular pores, each of the three other joints with four transverse rows of regular, circular pores. Mouth strongly constricted, half as broad as the third and fourth joints.

*Dimensions.*—Length of the shell (with four joints) 0·12; length of each joint 0·03, greatest breadth 0·06.

*Habitat.*—North Atlantic, depth 3600 fathoms (Morse).

#### 3. *Lithocampe nereidum*, Haeckel.

*Lithocampe nereidum*, Haeckel, 1862, Monogr. d. Radiol., p. 319.
*Eucyrtidium nereidum*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 242; Mikrogeol., Taf. xxxv. B, *b*, fig. 22.

Shell smooth, slenderly ovate, with four deep strictures. Five joints equal in length, the fourth being the broadest. Each joint with three transverse rows of small, regular, circular pores (some-

times in the fourth joint there are four rows). Mouth constricted, half as broad as the fourth joint. (In Ehrenberg's figure all five joints are delineated, but the greater part of the hemispherical cephalis is broken off.)

*Dimensions.*—Length of the shell (with five joints) 0·1, of each joint 0·02; breadth of the fourth joint 0·05.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 4. *Lithocampe radicula*, Ehrenberg.

*Lithocampe radicula*, Ehrenberg, 1838, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 130, Taf. iv. fig. 11.; Mikrogeol., 1854, Taf. xxii. fig. 23*a*.

Shell smooth, spindle-shaped, with five sharp strictures. Six joints equal in length, each with four transverse rows of regular, circular, double-edged pores. The third and fourth joints are the broadest, and equal. The constricted mouth is not broader than the hemispherical cephalis, scarcely one-fourth as broad as the third and the fourth joints. This remarkable species is the oldest known skeleton of a Radiolarian, a figure of it being given in 1838, *loc. cit.* (compare my Monograph, 1862, p. 3, 4, 331). But this figure of Ehrenberg is not quite accurate, and differs from other figures of the same species, which he afterwards (1854) published in his Mikrogeologie (*loc. cit.*). The best of these is fig. 23*a* in pl. xxii., and is identical with the typical form (common in Barbados), and according to this I have here framed my description. The sixth joint possesses a distinct (though small) terminal mouth; when this becomes closed, the species passes over into *Stichocapsa radicula*.

*Dimensions.*—Length of the shell (with six joints) 0·18, length of each joint (on an average) 0·03; breadth of the third and fourth joints 0·08, of the second and fifth 0·06 of the terminal mouth and the cephalis 0·03.

*Habitat.*—Fossil in Tertiary rocks of Barbados.

### 5. *Lithocampe ventricosa*, Haeckel.

*Dictyomitra ventricosa*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 102, Taf. iii. fig. 25.

Shell ovate, with six slight strictures. Seven joints nearly equal in length, each with four (or sometimes three or five) transverse rows of small, regular, circular pores, in the last joint the pores are larger. The fourth and fifth joints are the broadest, and are twice as broad as the constricted mouth.

*Dimensions.*—Length of the shell (with seven joints) 0·13 to 0·14; length of each joint 0·017 to 0·02, greatest breadth 0·083, mouth 0·04.

*Habitat.*—Fossil in Tertiary rocks of Sicily; Grotte, Caltanisetta.

### 6. *Lithocampe fusiformis*, n. sp.

Shell smooth, spindle-shaped, decreasing uniformly towards the two blunt poles, with eight or nine sharp strictures, and nine or ten joints of equal lengths, each with four transverse rows of regular,

hexagonal pores. The fourth and fifth joints are the broadest. The constricted mouth is twice as broad as the hemispherical cephalis, half as broad as the fourth joint.

*Dimensions.*—Length of the shell (with ten joints) 0·2, of each joint 0·02; breadth of the fourth joint 0·06, mouth 0·03.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Subgenus 2. *Lithocampium*, Haeckel, 1881, Prodromus, p. 437.

*Definition.*—The joints of the shell are very different in length.

### 7. *Lithocampe ovata*, n. sp. (Pl. 77, fig. 1).

Shell smooth, urceolate or ovate, with three sharp strictures. Four joints of different lengths, having the proportion 1 : 2 : 2 : 6. The fourth joint is inflated and the broadest. The mouth is constricted, short, tubular, of the same breadth as the hemispherical cephalis. Pores small, circular, in regular transverse rows; four rows in the first, four in the second, two in the third, and five in the fourth joint. The middle stricture is crossed by longitudinal ribs.

*Dimensions.*—Length of the shell (with four joints) 0·11. Length of the single joints, *a* 0·01, *b* 0·02, *c* 0·02, *d* 0·06; greatest breadth 0·055.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 8. *Lithocampe aquilonaris*, Haeckel.

*Lithocampe aquilonaris*, Haeckel, 1862, Monogr. d. Radiol., p. 317.
*Eucyrtidium aquilonare*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. p. 4, pl. i. fig. 9.

Shell smooth, subconical, with three distinct strictures. Four joints of different lengths, having the proportion 3 : 1 : 3 : 4. The fourth joint is the broadest, suddenly constricted, with a short tubular mouth of half the breadth. Pores subregular, circular, in transverse rows; three rows in the first joint, two in the second, four in the third, and three in the fourth joint.

*Dimensions.*—Length of the shell (with four joints) 0·11. Length of the single joints, *a* 0·03, *b* 0·01, *c* 0·03, *d* 0·04; breadth 0·06.

*Habitat.*—North Pacific, Kamtschatka (Bailey), Station 241, depth 2300 fathoms.

### 9. *Lithocampe quadrarticulata*, Haeckel.

*Lithocampe quadrarticulata*, Haeckel, 1862, Monogr. d. Radiol., p. 319.
*Eucyrtidium quadrarticulatum*, Ehrenberg, 1861, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 299.

Shell smooth, spindle-shaped, with three deep strictures. Four joints of different lengths = 1 : 3 : 4 : 3. The third joint is the broadest, being twice as broad as the constricted mouth of the fourth joint. Pores small, regular, circular, in transverse rows; two being in the first, three in the second, four in the third, three in the fourth joint.

*Dimensions.*—Length of the shell (with four joints) 0·11. Length of the single joints, *a* 0·015, *b* 0·03, *c* 0·04, *d* 0·025; greatest breadth 0·05.

*Habitat.*—North Atlantic (Greenland, depth 1600 fathoms, Ehrenberg), Station 64, surface.

10. *Lithocampe multiseriata*, Haeckel.

*Eucyrtidium multiseriatum*, Ehrenberg, 1872, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, page 293, Taf. vii. fig. 9.

Shell smooth, spindle-shaped, or slenderly ovate, with three sharp strictures. Four joints of different lengths = 3 : 4 : 5 : 10. The third and fourth joints nearly equal in breadth, and twice as broad as the hemispherical cephalis. The truncate mouth is slightly constricted. Pores very small and numerous, in regular transverse rows. Three or four rows in the first, five or six in the second, seven or eight in the third, and fifteen to twenty in the fourth joint.

*Dimensions.*—Length of the shell (with four joints) 0·11. Length of the single joints, *a* 0·015, *b* 0·02, *c* 0·025, *d* 0·05; breadth 0·045.

*Habitat.*—Tropical Pacific (Philippine Sea, Ehrenberg), Stations 206, 224, 266, in various depths.

11. *Lithocampe diploconus*, n. sp. (Pl. 77, fig. 3).

Shell rough, doubly conical, with three distinct strictures. Four joints of different lengths = 2 : 5 : 5 : 8. The third joint is the broadest. The three first joints form together a broad cone, and the fourth an inverse truncate cone; the latter is distinguished by convergent longitudinal ribs. Pores regular, circular, alternating with the ribs in the fourth joint. Truncate mouth hyaline, half as broad as the third joint.

*Dimensions.*—Length of the shell (with four joints) 0·2. Length of the single joints, *a* 0·02, *b* 0·05, *c* 0·05, *d* 0·08; breadth (in the middle part) 0·1.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

12. *Lithocampe diaphana*, Haeckel.

*Eucyrtidium diaphanum*, Ehrenberg, 1872, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 309.

Shell smooth, hyaline, spindle-shaped, decreasing uniformly towards both poles, with three distinct strictures. Four joints of different lengths; the second and third equal in breadth, twice as broad and three times as long as the first and the fourth. Pores very small and scarce, in transverse interrupted rows, commonly two rows in the first, two or three in the second, three or four in the third, and only one in the last joint. Mouth constricted, two-thirds as broad as the fourth joint.

*Dimensions.*—Length of the shell (with four joints) 0·13. Length of the single joints, *a* 0·015, *b* 0·05, *c* 0·05, *d* 0·015; breadth (in the middle part) 0·06, mouth 0·02.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

### 13. *Lithocampe hispida*, Haeckel.

*Lithocampe hispida*, Haeckel, 1862, Monogr. d. Radiol., p. 318.
*Eucyrtidium hispidum*, Ehrenberg, 1861, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 298; Abhandl. d. k. Akad. d. Wiss. Berlin, 1872, p. 291, Taf. ii. fig. 19.

Shell thorny, slenderly ovate, or nearly spindle-shaped, with four sharp strictures. Five joints of different lengths = 3 : 3 : 4 : 6 : 4. The fourth joint is the broadest, and nearly twice as broad as the constricted mouth. Pores small, circular, separated by longitudinal, spiny ribs, regularly disposed in transverse rows; three rows in the first and second, four rows in the third and fifth, six rows in the fourth joint.

*Dimensions.*—Length of the shell (with five joints) 0·1. Length of the single joints, *a* 0·015, *b* 0·015, *c* 0·02, *d* 0·03, *e* 0·02; greatest breadth 0·05.

*Habitat.*—Arctic Ocean (in different depths), Ehrenberg.

### 14. *Lithocampe tumidula*, Haeckel.

*Lithocampe tumidula*, Haeckel, 1862, Monogr. d. Radiol., p. 318.
*Eucyrtidium tumidulum*, Bailey, 1856, Amer. Journ. Sci. and Arts, vol. xxii. p. 5, pl. i. fig. 11.
*Eucyrtidium tumidulum*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 293, Taf. ii. fig. 12.
? *Eucyrtidium increscens*, Ehrenberg, 1861, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 299.
? *Lithocampe increscens*, Haeckel, 1862, Monogr. d. Radiol., p. 318.

Shell smooth, nearly spindle-shaped, with four sharp strictures, very similar to the preceding in size and form. It differs in the smooth surface, the absence of longitudinal ribs, and the unequal size of the pores, which form four transverse series in each joint, and are much larger in the broadest (fourth) joint. Proportion of the five joints = 2 : 2 : 3 : 5 : 4.

*Dimensions.*—Length of the shell (with five joints) 0·1. Length of the single joints, *a* 0·012, *b* 0·012, *c* 0·02, *d* 0·03, *e* 0·025; greatest breadth 0·05.

*Habitat.*—Cosmopolitan; Atlantic, Pacific; many stations, in different depths.

### 15. *Lithocampe heteropora*, Haeckel.

*Lithocampe heteropora*, Haeckel, 1862, Monogr. d. Radiol., p. 317.
*Eucyrtidium heteroporum*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 242.

Shell smooth, subconical, obtuse, with four distinct strictures. Five joints of different lengths = 2 : 4 : 3 : 3 : 2. The fourth joint is the broadest. Mouth slightly constricted. Pores regular, circular, in the second joint much larger than in the four others, disposed in transverse series; two rows in the first and fifth, three rows in the second, four rows in the third and fourth joints.

*Dimensions.*—Length of the shell (with five joints) 0·14. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·03, *d* 0·03, *e* 0·02; greatest breadth 0·07.

*Habitat.*—North Atlantic (depth 2000 fathoms, Ehrenberg), Canary Islands, surface, Haeckel.

16. *Lithocampe meta*, Stöhr.

*Lithocampe meta*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 103, Taf. iv. fig. 4.

Shell rough, subconical, obtuse, with four slight strictures. Five joints of different lengths = 2 : 4 : 5 : 4 : 2. The fourth joint is the broadest, and three times as broad as the constricted mouth. Pores, small, regular, circular, quincuncially disposed, equal in size; two transverse rows in the first and fifth, five rows in the second and fourth, six rows in the third joint.

*Dimensions.*—Length of the shell (with five joints) 0·14. Length of the single joints, *a* 0·017, *b* 0·033, *c* 0·04, *d* 0·033, *e* 0·017; greatest breadth 0·083.

*Habitat.*—Fossil in Tertiary rocks of Sicily, Grotte (Stöhr), Caltanisetta (Haeckel).

17. *Lithocampe urceolata*, n. sp. (Pl. 77, fig. 2).

Shell rough, wide, urceolate, without external strictures, but with four internal septal rings (not visible in the figure), each of which contains an internal circle of horizontal pores. Five joints of different lengths = 2 : 3 : 6 : 4 : 2. The third joint is the broadest, and three times as broad as the constricted mouth. Pores of very different sizes, irregular, roundish, with prominent polygonal frames. A very remarkable species.

*Dimensions.*—Length of the shell (with five joints) 0·17. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·06, *d* 0·04, *e* 0·02; greatest breadth 0·13.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

18. *Lithocampe clava*, Ehrenberg.

*Lithocampe clava*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 66, Taf. iv. fig. 2.

Shell smooth, club-shaped, or slenderly ovate, with five internal septal rings. Six joints of very different lengths = 5 : 2 : 3 : 4 : 5 : 18. The sixth joint is the broadest, and as long as the five others together. Pores small, circular, in the basal half of the last joint irregular and larger. Constricted mouth as broad as the subspherical, hyaline cephalis.

*Dimensions.*—Length of the shell (with six joints) 0·15. Length of the single joints, *a* 0·02, *b* 0·011, *c* 0·013, *d* 0·016, *e* 0·02, *f* 0·07.

*Habitat.*—Fossil in Barbados.

19. *Lithocampe hexacola*, n. sp. (Pl. 79, fig. 7).

Shell smooth, nearly spindle-shaped, without external strictures, but with five internal septal rings. Six joints of different lengths = 4 : 8 : 5 : 5 : 5 : 10. The fourth joint is the broadest, and four times as broad as the constricted mouth. Pores subregular hexagonal, or irregular polygonal, with thin bars.

*Dimensions.*—Length of the shell (with six joints) 0·18, greatest breadth 0·09. Length of the six joints, *a* 0·02, *b* 0·04, *c*, *d*, and *e* each 0·025, *f* 0·05.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

20. *Lithocampe heptacola*, n. sp. (Pl. 79, fig. 8).

Shell smooth, subcylindrical, constricted at both poles, with six distinct strictures. Seven joints of different lengths, the five abdominal joints nearly equal, each half as long as the hemispherical, vaulted thorax, and twice as long as the subspherical, small cephalis. Mouth constricted, with a short, tubular, hyaline peristome (like an eighth joint without pores), about one-third as broad as each of the four middle joints. Pores subregular hexagonal, or irregular polygonal, with thin bars.

*Dimensions.*—Length of the shell (with seven joints) 0·24, greatest breadth 0·09. Length of the cephalis 0·02, thorax 0·06, each of the four following joints 0·03, of the last joint 0·04.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

21. *Lithocampe octocola*, n. sp. (Pl. 79, fig. 6).

Shell smooth, subcylindrical, thick-walled, constricted at both poles, without distinct, external strictures, but with seven internal septal rings. Eight joints of different lengths; four joints (the second to the fifth) being about twice as long as the four others (the first and the three last). The constricted mouth only one-third as broad as the four middle joints. Pores small and numerous, subregular, circular.

*Dimensions.*—Length of the shell (with eight joints) 0·19, breadth 0·09. Length of the second to the fifth joints, each 0·03; length of the four other joints, each about 0·016.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

22. *Lithocampe polycola*, n. sp.

Shell smooth, subcylindrical, constricted at both poles, with twelve to fifteen distinct strictures. Fourteen to sixteen joints of different lengths. Cephalis flat, cap-shaped, hyaline, without pores. Thorax nearly hemispherical, with three transverse rows of small circular pores. Each following joint (each abdominal joint) only with a single row of small pores. The constricted mouth of the last joint only one-third as broad as the middle part of the shell. (Very similar to *Lithomitra eruca*, Pl. 79, fig. 3.)

*Dimensions.*—Length of the shell (with sixteen joints) 0·3, breadth 0·08. Length of the cephalis 0·02, thorax 0·06, each of the following joints 0·015, last joint 0·025.

*Habitat.*—Tropical Pacific, Station 224, depth 1850 fathoms.

Genus 651. *Spirocyrtis*,[1] Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with spirally-arranged constrictions on the shell. Cephalis with a horn.

The genus *Spirocyrtis* and the following closely allied genus *Spirocampe* differ from the other Stichocorida (and also from nearly all Cyrtoidea) in a very remarkable

[1] *Spirocyrtis* = Spiral basket; σπεῖρα, κυρτίς.

character. The annular constrictions of the multiarticulate shell and the corresponding internal annular septa are here not separated, and do not lie in parallel, transverse planes (as usually happens), but they are all or partly connected in the form of an ascending spiral, so that the joints are not perfectly separated. An irregularity or asymmetry of growth on the different sides of the shell is probably the cause of this strange, spiral structure.

### Subgenus 1. *Spirocyrtidium*, Haeckel.

*Definition.*—Shell conical, gradually dilating towards the wide open terminal mouth.

1. *Spirocyrtis scalaris*, n. sp. (Pl. 76, fig. 14).

Shell conical, gradually dilating towards the wide open mouth, with ten to twelve spiral convolutions, which correspond to the same number of short and broad chambers or joints, gradually increasing in breadth; all joints form together a spirally winding staircase. The length or height of the single joints or stairs is about equal, and each bears four or five transverse rows of small, square pores. Cephalis flat, cap-shaped, with two or three short divergent horns.

*Dimensions.*—Length of the shell (with ten joints or turnings) 0·16, length of each joint (on an average) 0·016; breadth of the third joint 0·04, of the fifth joint 0·07, of the tenth joint 0·1.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

2. *Spirocyrtis cornutella*, n. sp. (Pl. 76, fig. 13).

Shell conical, gradually dilating towards the wide mouth, similar to the preceding, but differing in the curved axis, and the broader and shorter joints, each of which bears only two or three transverse rows of square pores. The turnings of the staircase are not so sharp, nor so distinct, as in the preceding species. Cephalis with a single short horn.

*Dimensions.*—Length of the shell (with eight joints) 0·1; breadth of the fourth joint 0·05, of the eighth joint 0·08.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

### Subgenus 2. *Spirocyrtoma*, Haeckel.

*Definition.*—Shell ovate, or nearly spindle-shaped, more or less tapering towards the narrower, somewhat constricted mouth.

3. *Spirocyrtis holospira*, n. sp. (Pl. 76, fig. 16).

Shell subovate, twice as long as broad, without external strictures, but with an internal regularly descending spiral septum, which separates seven to nine broad joints of nearly equal lengths; the

first and second joints together are conical, and about as long as each of the following joints. Cephalis small, hemispherical, with a thick pyramidal horn of the same length. The fifth joint is the broadest, the truncate mouth is slightly constricted (in the specimen figured it is broken off). Pores regular, circular, quincuncial.

*Dimensions.*—Length of the shell (with eight joints) 0·2, breadth 0·1; length of each joint, about 0·03.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 4. *Spirocyrtis hemispira*, n. sp.

Shell slender, nearly spindle-shaped, three times as long as broad, without external strictures, but with ten to eleven internal septa. The five or six upper of these are perfectly separate, complete parallel rings; the five or six lower are spirally connected. The eleven or twelve joints gradually taper in length and breadth, from the broadest middle towards the two constricted ends of the shell. The middle (fifth or sixth) joint is the broadest, and is three to four times as broad as the constricted mouth. Cephalis small, hemispherical, with a conical horn of the same length. Pores regular, circular, hexagonally framed.

*Dimensions.*—Length of the shell (with twelve joints) 0·25, breadth 0·09; length of the middle joint 0·03.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 5. *Spirocyrtis merospira*, n. sp. (Pl. 76, fig. 15).

Shell ovate, with six to eight slight strictures, twice as long as broad. The three or four upper joints are perfectly separated by annular septa, the three or four lower joints connected by an internal spiral septum. The spiral line is often more or less irregular or interrupted (as is also the case in the specimen figured). Mouth rather wide. Pores small, subregular, circular. A rather variable species.

*Dimensions.*—Length of the shell (with eight joints) 0·2, breadth 0·1.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

### 6. *Spirocyrtis diplospira*, n. sp. (Pl. 76, fig. 17).

Shell slender, ovate, with seven to eight slight strictures. All eight or nine joints are connected by an internal double spiral septum, the first spiral beginning from the ventral side, the second from the dorsal side of the collar stricture. Length and breadth of the single joints rather variable and irregular; the broadest joint is commonly the fifth. Mouth more or less constricted. Pores subregular, circular. This remarkable species differs from all other Cyrtoidea by the double spiral septum of the joints.

*Dimensions.*—Length of the shell (with eight joints) 0·2, breadth 0·1.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Genus 652. *Spirocampe*,[1] Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Stichocorida (vel Stichocyrtida eradiata aperta) with spirally arranged constrictions on the shell. Cephalis without horn.

The genus *Spirocampe* has the same peculiar spiral structure of the shell as the preceding *Spirocyrtis*, and differs from it only in the absence of a cephalic horn. It exhibits, therefore, the same relation to the latter as the similar *Lithocampe* bears to *Eucyrtidium*.

1. *Spirocampe callispira*, n. sp. (Pl. 76, fig. 11).

Shell ovate, smooth, with six joints, connected in the form of a complete winding staircase. All the windings are nearly at equal distances; each bears one row of large roundish pores, enclosed by two rows of smaller pores. Cephalis hemispherical, of about the same breadth as the constricted, short tubular mouth.

*Dimensions.*—Length of the shell (with six joints) 0·15, breadth 0·09; mouth 0·03 diameter.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

2. *Spirocampe allospira*, n. sp. (Pl. 76, fig. 12).

Shell subcylindrical, or nearly spindle-shaped, smooth, very thick-walled, with eight joints alternately longer and shorter, and connected in the form of an irregular spiral. The distance between the windings is very variable. Pores small, regular, circular. Cephalis hemispherical, of about the same size as the short tubular mouth.

*Dimensions.*—Length of the shell (with eight joints) 0·2, breadth 0·08; mouth 0·03 diameter.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

3. *Spirocampe polyspira*, n. sp.

Shell cylindrical, rough, with twelve joints nearly equal in length, connected in the form of a regular, complete spiral. All windings are at the same distance. Pores regular, circular, three rows on each turning. Cephalis flat, cap-shaped, half as broad as the slightly constricted, not tubular mouth.

*Dimensions.*—Length of the shell (with twelve joints) 0·24, breadth 0·07; mouth 0·05 diameter.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Subfamily 2. STICHOCAPSIDA, Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Lithocampida with the terminal mouth of the shell fenestrated (vel Stichocyrtida eradiata clausa).

[1] *Spirocampe*=Spiral caterpillar; σπεῖρα, κάμπη.

Genus 653. *Cyrtocapsa*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichocapsida (vel Stichocyrtida eradiata clausa) with an apical horn on the cephalis, without basal terminal spine.

The genus *Cyrtocapsa* and the two following genera represent together the small sub-family of Stichocapsida, or of those Cyrtoidea in which the many-jointed shell bears no radial appendages, and the terminal mouth is closed by a lattice-plate. They have been derived from the Stichocorida by development of such a closing plate. *Cyrtocapsa* bears an apical horn on the cephalis, and may be derived therefore directly from *Eucyrtidium*.

Subgenus 1. *Cyrtocapsella*, Haeckel.

*Definition.*—Shell with three annular strictures (or internal septa) and four distinct joints.

1. *Cyrtocapsa tetrapera*, n. sp. (Pl. 78, fig. 5).

Shell rough, pear-shaped, with three deep strictures. The three first joints are of equal lengths, and each half as long as the hemispherical fourth joint. Cephalis subspherical, with an oblique conical horn of the same length. The third joint is the broadest, three times as broad as long. Pores regular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·15, breadth 0·09; length of each of the three first joints 0·03, of the last 0·06.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

2. *Cyrtocapsa compacta*, n. sp. (Pl. 77, fig. 8).

*Eucyrtidium compactum*, Haeckel, 1878, Atlas, *loc. cit.*

Shell rough, pear-shaped, with three slight strictures. The hemispherical cephalis bears a thick pyramidal spine of the same length, and is half as long as the second and the third joints, one-third as long as the hemispherical fourth joint. The third joint is the broadest, three times as broad as long. Pores subregular, circular. In the centre of the basal pole is one larger pore, the remnant of the constricted mouth of *Eucyrtidium*.

*Dimensions.*—Length of the shell (with four joints) 0·16, breadth 0·12. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·04, *d* 0·06.

*Habitat.*—Western Tropical Pacific, Station 206, depth 2100 fathoms.

[1] *Cyrtocapsa* = Basket-capsule; κυρτός, κάψα.

3. *Cyrtocapsa inflata*, n. sp.

Shell spiny, pear-shaped, with three deep strictures. The inflated third joint is twice as long as the second and fourth joints, and three times as long as the hemispherical cephalis, which bears a large conical horn of three times the length. Fourth joint flat, vaulted, inversely cap-shaped. The third joint is the broadest, being twice as broad as long. Pores regular, circular, double-contoured.

*Dimensions.*—Length of the shell 0·14, breadth 0·11. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·06, *d* 0·03.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

4. *Cyrtocapsa pyrum*, n. sp. (Pl. 78, fig. 8).

Shell thorny, pear-shaped, without external strictures, but with three internal annular septa. Length of the four joints = 2 : 5 : 6 : 7. The fourth joint is the broadest, being about twice as broad as long, and hemispherical. The small subspherical cephalis bears a stout conical horn of the same length. Pores large, regular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·2, breadth 0·12. Length of the single joints, *a* 0·02, *b* 0·05, *c* 0·06, *d* 0·07.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

5. *Cyrtocapsa cornuta*, n. sp. (Pl. 78, fig. 9).

Shell rough, very thick-walled, nearly pear-shaped, with three annular strictures; the second of which is very sharp, the first and third slight. Length of the four joints = 3 : 4 : 5 : 6. The third joint is the broadest, being about twice as broad as long; the fourth joint is hemispherical. Cephalis subspherical, with a large, conical, curved horn of twice the length. Pores regular, circular, hexagonally framed.

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·12. Length of the single joints, *a* 0·03, *b* 0·04, *c* 0·05, *d* 0·06.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

6. *Cyrtocapsa diploconus*, n. sp. (Pl. 78, fig. 6).

Shell rough, doubly conical, with three annular septa. Length of the four joints = 3 : 4 : 4 : 8. The third joint is the broadest, two and a half times as broad as long; the fourth is inversely conical, acute. Cephalis hemispherical, with a pyramidal horn of the same length. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with four joints) 0·19, breadth 0·1. Length of the single joints, *a* 0·03, *b* 0·04, *c* 0·04, *d* 0·08.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

7. *Cyrtocapsa fusulus*, n. sp. (Pl. 78, fig. 7).

Shell smooth, spindle-shaped, with three distinct strictures. Length of the four joints = 1 : 1 : 4 : 3. The third joint is the broadest, somewhat longer than broad. The fourth joint is inversely conical. Cephalis hemispherical, with a coronal of large, ovate pores, and a pyramidal, sulcate, oblique horn of twice the length. Pores regular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·18, breadth 0·07. Length of the single joints, *a* 0·02, *b* 0·02, *c* 0·08, *d* 0·06.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

## Subgenus 2. *Cyrtocapsoma*, Haeckel.

*Definition.*—Shell with four or more annular septa, and five or more joints.

8. *Cyrtocapsa incrassata*, Haeckel.

*Eucyrtidium incrassatum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 105, Taf. iv. fig. 9.

Shell rough, spindle-shaped, with four annular septa. Length of the five joints = 2 : 3 : 4 : 4 : 4. The third joint is the broadest, nearly three times as broad as long. The fourth joint is inversely conical, acute. Cephalis small, spherical, with two short, conical, divergent horns. Pores small, regular, circular.

*Dimensions.*—Length of the shell (with five joints) 0·17, breadth 0·11. Length of the single joints, *a* 0·015, *b* 0·035, *c* 0·04, *d* 0·04, *e* 0·04.

*Habitat.*—Fossil in Tertiary rocks of Sicily, Grotte.

9. *Cyrtocapsa costata*, n. sp.

Shell smooth, spindle-shaped, twice as long as broad, with numerous longitudinal ribs, and four annular septa. Length of the five joints = 1 : 4 : 3 : 2 : 8. The third joint is the broadest. Fourth joint inversely conical, acute. Cephalis small, hemispherical, with a small conical horn. Pores regular, circular.

*Dimensions.*—Length of the shell (with five joints) 0·18, breadth 0·09. Length of the single joints, *a* 0·01, *b* 0·04, *c* 0·03, *d* 0·02, *e* 0·08.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

10. *Cyrtocapsa colatractus*, n. sp.

Shell smooth, spindle-shaped, with eight internal annular septa (without external stricture). All nine joints are nearly equal in length, the first somewhat shorter, the last longer. The fourth joint is the broadest, four times as broad as long. Last joint inversely conical, blunt. Cephalis subspherical, with a conical horn of the same length. Pores small and numerous, regular, circular.

*Dimensions.*—Length of the shell (with nine joints) 0·22, breadth 0·1; length of the cephalis 0·015, of the last joint, 0·03, of each of the seven other joints, 0·022 to 0·028.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 11. *Cyrtocapsa chrysalidium*, n. sp. (Pl. 76, fig. 9).

Shell rough, nearly spindle-shaped, with seven distinct strictures. Length of the eight joints = 4 : 6 : 11 : 8 : 5 : 5 : 4 : 3. The third and fourth joints are the broadest. The last joint is small, inversely cap-shaped. Cephalis subspherical, with an oblique, dentate horn of the same length. Pores very numerous, subregular, circular.

*Dimensions.*—Length of the shell (with eight joints) 0·23, breadth 0·1. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·055, *d* 0·04, *e* 0·025, *f* 0·025, *g* 0·02, *h* 0·015.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

## Genus 654. *Stichocapsa*,[1] Haeckel, 1881, Prodromus, p. 439.

*Definition.*—Stichocapsida (vel Stichocyrtida eradiata clausa) without apical horn, and without basal spine.

The genus *Stichocapsa* differs from the preceding *Cyrtocapsa* in the absence of an apical horn, and bears therefore to it the same relation as *Lithocampe* does to *Eucyrtidium*. It may be derived either from *Cyrtocapsa* by loss of the horn, or from *Eucyrtidium* by closure of the terminal mouth.

### 1. *Stichocapsa tetracola*, n. sp. (Pl. 78, fig. 1).

Shell smooth, spindle-shaped, half as broad as long, with three slight strictures. Length of the four joints = 3 : 4 : 4 : 11. The fourth joint is the broadest, inversely conical, with acute basal pole. Pores subregularly square in the second and third joints, more irregular in the fourth joint.

*Dimensions.*—Length of the shell (with four joints) 0·11. Length of the single joints, *a* 0·015, *b* 0·02, *c* 0·02, *d* 0·055; breadth 0·055.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 2. *Stichocapsa quadrigata*, n. sp. (Pl. 78, fig. 3).

Shell smooth, pear-shaped, half as broad as long, with three deep strictures. Length of the four joints = 3 : 8 : 8 : 5. The second joint is the broadest. The fourth joint is scarcely larger than the hemispherical cephalis; inversely conical, with blunt basal pole. Pores subregular, square, in transverse rows, in the second and third joints of equal size, in the fourth smaller.

*Dimensions.*—Length of the shell (with four joints) 0·12. Length of the single joints, *a* 0·015, *b* 0·04, *c* 0·04, *d* 0·025; breadth 0·06.

*Habitat.*—Central Pacific, Station 270, depth 2925 fathoms.

[1] *Stichocapsa* = Jointed capsule; στίχος, κάψα.

3. *Stichocapsa tricincta*, n. sp. (Pl. 78, fig. 2).

Shell smooth, spindle-shaped, twice as long as broad, with three deep strictures. Length of the four joints = 2 : 5 : 5 : 10. The third joint is the broadest. Fourth joint inversely conical, with acute basal pole. Cephalis small, subconical. Pores irregular, roundish, of very different sizes.

*Dimensions.*—Length of the shell 0·11. Length of the single joints, *a* 0·01, *b* 0·025, *c* 0·025, *d* 0·05; breadth 0·055.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

4. *Stichocapsa subglobosa*, n. sp.

Shell thorny, broad, pear-shaped, nearly spherical, almost as broad as long, with three internal septal rings. Length of the four joints = 1 : 2 : 7 : 2. Cephalis small, subspherical. Thorax flat, conical. Third joint very large, inflated, about twice as broad as the second and fourth joints. The latter is flat, cap-shaped, with rounded basal pole. Pores regular, circular, hexagonally framed, in the third joint twice as broad as in the second and fourth joints.

*Dimensions.*—Length of the shell 0·24. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·14, *d* 0·04; breadth 0·2.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

5. *Stichocapsa compressa*, Haeckel.

*Lithocampe compressa*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 103, Taf. iv. fig. 5.

Shell rough, broad, pear-shaped, almost as broad as long, with three internal septal rings. Length of the four joints = 1 : 2 : 3 : 2. Cephalis very small, spherical. Thorax conical. The third joint is the broadest, strongly inflated. The fourth joint (in the figure of Stöhr broken off) is in a well preserved specimen inversely hemispherical, with rounded basal pole. Pores very small, regular, circular.

*Dimensions.*—Length of the shell 0·1. Length of the single joints, *a* 0·013, *b* 0·027, *c* 0·04, *d* 0·022; breadth 0·08.

*Habitat.*—Fossil in Tertiary rocks of Sicily; Grotte, Caltanisetta.

6. *Stichocapsa pyriformis*, n. sp.

Shell rough, pear-shaped, about twice as long as broad, with three internal septal rings. Length of the four joints = 2 : 5 : 2 : 9. Cephalis small, spherical, hyaline. Thorax conical. Third joint very short and broad; the fourth joint is the broadest, half as long as the shell, with an inversely hemispherical basal pole. Pores subregular, circular, small and numerous, larger in the basal third.

*Dimensions.*—Length of the shell 0·18. Length of the single joints, *a* 0·02, *b* 0·05, *c* 0·02, *d* 0·09; breadth 0·1.

*Habitat.*—Fossil in Barbados.

7. *Stichocapsa monstrosa*, n. sp. (Pl. 78, fig. 4).

Shell tuberculate, twice as long as broad, irregular, horn-shaped or inversely conical, with curved axis, and with three internal septal rings. Length of the four joints = 2 : 7 : 3 : 4. Cephalis subspherical, with small, circular pores. The thorax is the broadest joint, half as long as the shell. The fourth joint is small, inversely conical, with a blunt, curved, basal pole. Pores irregular, roundish, partly double-contoured.

*Dimensions.*—Length of the shell (with four joints) 0·16. Length of the single joints, *a* 0·02, *b* 0·07, *c* 0·03, *d* 0·04; breadth 0·08.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

8. *Stichocapsa pentacola*, n. sp. (Pl. 76, fig. 1).

Shell smooth, slender, pear-shaped, twice as long as broad, with four sharp strictures. Length of the five joints = 1 : 1 : 1 : 2 : 3. The three first joints are nearly equal in length, but increase in breadth. The fifth joint is the broadest, nearly spherical, with rounded basal pole. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with five joints) 0·13. Length of the single joints, *a* 0·017, *b* 0·017, *c* 0·017, *d* 0·028, *e* 0·05; breadth 0·07.

*Habitat.*—Central Pacific, Station 273, depth 2350 fathoms.

9. *Stichocapsa hexacola*, n. sp. (Pl. 76, fig. 2).

Shell rough, slender, pear-shaped, twice as long as broad, with five internal septal rings. The five first joints are nearly equal in length. The sixth joint is the broadest, half as long as the shell, with a rounded, hemispherical basal pole. Pores small and numerous, subregular, circular, larger in the inflated basal third.

*Dimensions.*—Length of the shell (with six joints) 0·2. Length of each of the first five joints 0·02, of the sixth joint 0·1; breadth 0·1.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms; also fossil in Barbados.

10. *Stichocapsa compacta*, n. sp. (Pl. 76, fig. 3).

Shell rough very thick-walled, slender, pear-shaped, twice as long as broad, without external stricture, but with eight internal septal rings. The eight first joints, gradually increasing in breadth, are nearly equal in length. The eighth joint is the broadest, and one-third as long as the shell, inversely hemispherical. Pores small, circular, in the last joint larger.

*Dimensions.*—Length of the shell (with nine joints) 0·25. Length of each of the eight first joints about 0·02, of the ninth joint 0·08; breadth 0·13.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms; also fossil in Barbados.

### 11. *Stichocapsa radicula*, Haeckel.

*Lithocampe radicula*, Ehrenberg, 1838 (*partim*); Mikrogeol., 1854, Taf. xxii. fig. 23*b*.?

Shell smooth, spindle-shaped, decreasing from the broader middle towards the two rounded poles, with four or five slight strictures. All five or six joints nearly equal in length, the middle (third and fourth) are the broadest. Pores subregular, circular. (To this species those forms of *Lithocampe radicula*, Ehrenberg, must be referred, in which the basal opening is perfectly closed by lattice-work. The other forms in which the basal mouth remains open, and which are connected with the former by transitional forms, constitute the true type of the genus *Lithocampe* (page 1503).

*Dimensions.*—Length of the shell (with six joints) 0·12 to 0·15, breadth 0·06 to 0·07.

*Habitat.*—Fossil in Barbados.

### 12. *Stichocapsa subligata*, Haeckel.

*Lithocampe subligata*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 102, Taf. iv. fig. 1.

Shell rough, subcylindrical, irregular, with seven slight strictures. All eight joints of slightly different lengths, the third joint is the broadest; the seventh joint is much broader than the sixth and the eighth joints. The latter is inversely hemispherical. Cephalis very small, spherical. Pores regular, circular, very small and numerous.

*Dimensions.*—Length of the shell (with eight joints) 0·24; length of the single joints (on an average) 0·025 to 0·035, breadth 0·08.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Grotte).

### 13. *Stichocapsa paniscus*, n. sp. (Pl. 76, fig. 4).

Shell smooth, cylindrical, with a blunt, conical cephalis, and a hemispherical last joint, without external strictures, but with seven or eight internal septa. Eight or nine joints nearly equal in length, the second and the last somewhat longer. Pores circular, of unequal sizes.

*Dimensions.*—Length of the shell (with seven joints) 0·16; length of each joint (on an average) 0·02 to 0·03, breadth 0·07.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 14. *Stichocapsa cylindrica*, n. sp.

Shell rough, cylindrical, four times as long as broad, with hemispherical cephalis and last joint, without external stricture, but with ten or eleven internal septa. All eleven or twelve joints are nearly equal in length, and are three times as broad as long. Only the flat cephalis is shorter, and the vaulted last joint longer than each of the nine or ten other joints. Pores regular, circular.

*Dimensions.*—Length of the shell (with twelve joints) 0·24; length of each joint (on an average) 0·02, breadth 0·06.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

Genus 655. *Artocapsa*,[1] Haeckel, 1881, Prodromus, p. 438.

*Definition.*—Stichocapsida (vel Stichocyrtida eradiata clausa) with an apical horn on the cephalis, and a basal terminal spine on the last joint.

The genus *Artocapsa* differs from *Cyrtocapsa*, its ancestral form, by the development of a vertical terminal spine, or a bunch of spines, on the base of the last joint, and bears therefore to it the same relation as *Rhopalatractus* does to *Rhopalocanium*.

1. *Artocapsa fusiformis*, n. sp. (Pl. 76, fig. 5).

Shell spindle-shaped, rough, with five slight strictures, decreasing uniformly from the broader middle towards both poles, with a strong, pyramidal, terminal spine at each pole. Length of the six joints = 2 : 5 : 3 : 3 : 2 : 5. Cephalis hemispherical, hyaline, without pores, its horn half as large as the basal spine. Pores small and numerous, subregular, circular.

*Dimensions.*—Length of the shell (with six joints) 0·2, breadth 0·09. Length of the single joints, *a* 0·02, *b* 0·05, *c* 0·03, *d* 0·03, *e* 0·02, *f* 0·05.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

2. *Artocapsa spinosa*, n. sp. (Pl. 76, fig. 10).

Shell spindle-shaped, spiny, with five distinct strictures. Length of the six joints = 2 : 3 : 2 : 5 : 4 : 4. The fourth joint is the broadest, and much larger than the five other joints. The first and the last joints are similar in size and form, hemispherical, armed with some larger, irregular, conical spines. Pores irregular, roundish, of variable sizes.

*Dimensions.*—Length of the shell (with six joints) 0·2, breadth 0·09. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·02, *d* 0·05, *e* 0·04, *f* 0·04.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

3. *Artocapsa infracaleata*, Haeckel.

*Eucyrtidium infraculeatum*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 106, Taf. iv. fig. 13.

Shell subcylindrical, rough, with five annular septa. Length of the six joints = 2 : 3 : 4 : 4 : 4 : 3. The third, fourth, and fifth joints are nearly equal in length and breadth, whilst the second and sixth are cupola-shaped. The cephalis is very small, subspherical (regarded by Stöhr as a "large pore"), and bears a short conical horn. The last joint bears a bunch of basal spines.

*Dimensions.*—Length of the shell (with six joints) 0·2, breadth 0·09. Length of the cephalis 0·02, second and sixth joints 0·03, third, fourth, and fifth joints 0·04.

*Habitat.*—Fossil in Tertiary rocks of Sicily; Grotte (Stöhr), Caltanisetta (Haeckel).

[1] *Artocapsa* = Bread-shaped capsule; ἄρτος, κάψα.

4. *Artocapsa quadricamera*, n. sp.

Shell spindle-shaped, smooth, with three sharp strictures. Length of the four joints = 2 : 3 : 4 : 8. The third joint is the broadest. The fourth joint is inversely conical, nearly as long as the three other joints together, and bears a strong, conical, basal spine, of half the length. The cephalis is small, subspherical, and bears a conical horn of the same length. Pores subregular, circular.

*Dimensions.*—Length of the shell (with four joints) 0·17, breadth 0·08. Length of the single joints, *a* 0·02, *b* 0·03, *c* 0·04, *d* 0·08.

*Habitat.*—Fossil in Barbados.

5. *Artocapsa armata*, n. sp.

Shell slender, inversely ovate, spiny, with six deep strictures. Length of the seven joints = 2 : 4 : 6 : 5 : 4 : 3 : 2. The third joint is the broadest, inflated, and much larger than the four following, which gradually decrease in size. The small, hemispherical cephalis bears a stout pyramidal horn of twice the length. The last hemispherical joint is armed with a bunch of stout spines, one of which is much the larger, and as long as the third joint. Pores irregular, roundish.

*Dimensions.*—Length of the shell (with seven joints) 0·26, breadth 0·12. Length of the single joints, *a* 0·02, *b* 0·04, *c* 0·06, *d* 0·05, *e* 0·04, *f* 0·03, *g* 0·02.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4575 fathoms.

6. *Artocapsa octocamera*, n. sp.

Shell subcylindrical, smooth, with seven internal annular septa. Five joints (the third to the seventh) are nearly equal in size, while the second and eighth are cupola-shaped, somewhat longer. The cephalis is smaller, with a conical horn of the same length. The last joint bears a bunch of divergent, conical spines, of different lengths. Pores small, regular, circular.

*Dimensions.*—Length of the shell (with eight joints) 0·16, breadth 0·08. Length of the cephalis 0·016, second and eighth joints 0·033, each of the five other joints 0·022.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

7. *Artocapsa elegans*, n. sp. (Pl. 76, fig. 8).

Shell spindle-shaped, smooth, with eight internal, broad, annular septa. The second and third joints are the largest, the fourth and fifth of medium size, while the cephalis and the four last joints are nearly equal in length, and much shorter. The third joint is the largest. The subspherical cephalis bears a bristle-shaped horn of the same length, while the last joint is armed with a bunch of conical spines. Pores small, in the upper half of the shell regular, hexagonal, in the lower half irregular.

*Dimensions.*—Length of the shell (with nine joints) 0·2, breadth 0·09. Length of the first and the four last joints, each 0·014; of the fourth and fifth, each 0·02; of the third 0·04, second 0·05.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

# Legion IV. PHÆODARIA,

## vel Cannopylea, vel Pansolenia (Pls. 99–128).

*Phæodaria*, Haeckel, 1879.
*Tripylea*, Hertwig, 1879.
*Cannopylea*, Haeckel, 1881.
*Pansolenia*, Haeckel, 1878.

*Definition.*—Radiolaria with a double membrane surrounding the central capsule, which bears on one pole of the main axis a peculiar astropyle, or a tubular main-opening, in the centre of a circular radiate operculum. Usually (but not constantly) a pair of small, lateral, accessory openings (or parapylæ) on the opposite pole of the main axis. Extracapsulum constantly with a phæodium, or with a voluminous aggregation of peculiar dark pigment bodies (phæodella) covering the astropyle of the central capsule. Skeleton siliceous or silicated, always extracapsular, very rarely wanting. Fundamental form very variable, originally monaxon, often dipleuric or bilateral.

The legion PHÆODARIA, or CANNOPYLEA, in the extent here defined, was constituted by me in 1878, in my Protistenreich (p. 102) under the name PANSOLENIA. This name was given on the supposition that the skeleton of these interesting Radiolaria is always composed of hollow tubules, in contrast to that of the other Radiolaria, where it is never tubular. But I was soon convinced that this supposition was erroneous, that in a great part of the PANSOLENIA the skeleton is not composed of hollow tubules but of solid bars, and that a constant, very characteristic, and never failing mark of this group is to be found in the peculiar phæodium, a voluminous, constant, extracapsular pigment body. Therefore, in 1879, I changed the name into PHÆODARIA, and having discovered in the collection of the Challenger an astonishing number of new and wonderful types of this group, I described, in a preliminary note on it, four different orders and ten families with thirty-eight genera (Ueber die Phæodarien, eine neue Gruppe kieselschaliger mariner Rhizopoden; in Sitzungsberichte der Jenaischen Gesellschaft für Medicin and Naturwissenschaft. Sitzung vom, 12th December 1879).

In the same year (1879), Richard Hertwig, in his excellent work entitled Der Organismus der Radiolarien, published the first accurate description of the intimate structure of the soft body of the PANSOLENIA, and mainly of their central capsule; and having always observed, in the few representatives examined by him, three openings in the capsule (one main-opening and two accessory openings), he called them TRIPYLEA (*loc. cit.* p. 87), being guided by the erroneous supposition that these three openings are

constant in all members of the group. But this is by no means the case. The two accessory openings are completely absent in several families, whilst in others their number is increased. A constant and very striking character, however, of all PHÆODARIA, is the peculiar structure of their tubular main-opening, which I call astropyle, with its radiate operculum and cannular proboscis. On account of this important and startling characteristic I proposed in 1881 to call this group CANNOPYLEA. The two names PHÆODARIA and CANNOPYLEA both express a very striking and quite constant character of these curious Radiolaria, whilst the two names PANSOLENIA and TRIPYLEA are applicable only to a part of the whole legion.

The history of our knowledge of the PHÆODARIA is short, but very remarkable. Although hundreds of species, many of them cosmopolitan, are distributed over all oceans and all zones, although their size is in general much greater than that of the other Radiolaria (usually 1 to 2 mm., often even 5 to 10 mm. or more), and although their form and structure are usually striking, nevertheless the PHÆODARIA remained completely unknown up to the year 1859. During that year I observed the first forms living in the Gulf of Messina, and described and figured in 1862 in my Monograph five genera and seven species, viz., (1) *Aulacantha scolymantha* (p. 263), (2) *Thalassoplancta cavispicula* (p. 261, now *Cannobelos cavispicula*), (3) *Aulosphæra trigonopa*, and *Aulosphæra elegantissima* (p. 359), (4) *Spongodictyum trigonizon* (p. 459, now *Sagoplegma trigonizon*), and (5) *Cœlodendrum ramosissimum*, and *Cœlodendrum gracillimum* (p. 361). I recognised the structure of the three genera enumerated as 1, 3, and 5, as so remarkable and so different from that of the other Radiolaria, that I founded three peculiar families for them, the Aulacanthida, Aulosphærida, and Cœlodendrida.

The first note on the numerous remarkable PHÆODARIA discovered by the Challenger, and mainly on the large-sized inhabitants of the deep-sea, was published in 1876 by Dr. John Murray, in his Preliminary Reports on Work done on Board the Challenger (Proc. Roy. Soc., vol. xxiv., read March 16, 1876). He pointed out (*loc. cit.*, p. 535), that the tow-nets, sent down to a great depth (according to a new plan, adopted in April 1875) brought up on every occasion a great many new and peculiar Rhizopods, which had never been observed in the nets used near the surface. "The shells of all have an exceedingly beautiful tracery, a fenestrated appearance often, which a closer examination shows to be caused by pit-like depressions. Some have only one, others have several openings, through which the sarcode flows. The sarcode of all these deep-sea Rhizopods has many large black-brown pigment-cells. At times they come up with a good deal of the sarcode outside of the shell; and two specimens have been seen to throw out elongated pseudopodia" (*loc. cit.*, p. 536). Dr. John Murray distinguished at that time not less than fifty species of these interesting deep-sea Rhizopods and called them provisionally Challengerida; a term which we retain here for the largest and most characteristic family. He gave at the same time, in an accompanying plate (xxiv.), six

figures of new PHÆODARIA, the names of which (as found by me in 1879 in the corresponding preparations) are the following; (1) *Challengeria naresii*, (2) *Challengeria aldrichii*, (3) *Bivalva compressa* (now = *Conchopsis compressa*), (4) *Tuscarora belknapii*, (5) *Challengeria circopora* (now = *Circoporus sexfurcus*), and (6) *Haeckeliana porcellana*. A great number of these Challengerida (twenty species) were afterwards figured by Dr. John Murray in the Narrative of the Cruise of H.M.S. Challenger, 1885, vol. i. part 1, p. 226, Pl. A; viz., fourteen species of *Challengeria* and six species of *Tuscarora*.

The most important advance in the knowledge which we had of the peculiar organisation of the PHÆODARIA, was made by the accurate description which Richard Hertwig published, in 1879, of the intimate structure of their central capsule, and mainly of its peculiar openings. He examined living at Messina the following three forms, described in my Monograph; (1) *Aulacantha scolymantha*, (2) *Aulosphæra elegantissima*, and (3) *Cœlodendrum ramosissimum*. Besides, he described an interesting new genus, *Cœlacantha anchorata;* and another new form, which he placed in the Aulosphærida, as *Aulosphæra gracilis*, but which really was a new genus of Sagosphærida, here described as *Sagoscena gracilis*. Finally, Hertwig first discovered that the peculiar bodies, described by Ehrenberg as *Dictyocha* and placed by him in the *Diatomea* (*Polygastrica*), were the isolated pieces of the skeleton of a true *Phæodarium*, and that they were scattered loosely in great numbers over the surface of the jelly-sphere, just as are the hollow spicula of *Thalassoplancta* or *Cannobelos*.

The six species mentioned, of which Hertwig gave a very accurate description and very instructive figures, belong to six different genera, and these represent six different families of PHÆODARIA, viz.; Aulacanthida, Aulosphærida, Cœlodendrida, Cannosphærida, Sagosphærida and Cannorrhaphida. He found that all these six forms, in spite of great differences in the form and structure of their skeleton, were identical in the structure of the central capsule; and since he observed constantly three openings in its double wall (a large main-opening on the oral pole, and a pair of lateral accessory openings on the aboral pole of its main axis) he called them TRIPYLEA (*loc. cit.*, p. 87, 94). But he also pointed out the remarkable shape of their voluminous extracapsular body, and especially the characteristic position, size, colour and composition of the large pigment body, which I had called the phæodium.

The accurate description of the gigantic and elegant skeleton of a new *Phæodarium*, surpassing all other known Radiolaria in its extraordinary size (15 mm.), was published in 1882 by O. Bütschli (in Zeitschr. f. wiss. Zool., vol. xxxvi. p. 486, Taf. xxxi.). He called it *Cœlothamnus davidoffii*, in honour of its discoverer, who had found it floating on the surface of the Gulf of Villafranca, near Nice. He placed it among the Cœlodendrida; it belongs, however, to that part of this group which possesses a nasal tube, and which I afterwards separated under the name Cœlographida.

The total number of PHÆODARIA, hitherto described and illustrated by figures, amounts therefore to seventeen species, viz., the seven species first described by myself (in 1862); the six new species figured by Dr. John Murray (in 1876); the three new species discovered by Hertwig (in 1879) and the single species last-mentioned described by Bütschli (in 1882). The rich collection of the Challenger has added to this small number such an astonishing wealth of new and remarkable forms, that I can describe in the following system of PHÆODARIA not less than eighty-four genera and four hundred and sixty-five species. These belong to fifteen different families and four different orders. But this great number is probably only a small part of the numerous interesting PHÆODARIA, which are abundantly distributed over all the oceans; those (*e.g.*) of the Indian and of the Arctic Oceans are almost unknown.

The great majority of these wonderful PHÆODARIA are inhabitants of the deep-sea, mainly of the southern hemisphere, and are so common in many stations explored by the Challenger, that its collection contains many thousands (or rather hundreds of thousands) of well-preserved specimens. A smaller part of the legion is found on the surface, widely distributed over all oceans; some of these are very common (as, *e.g.*, *Aulacantha*, *Aulosphæra*, *Sagosphæra*, *Cœlodendrum*, *Castanella*, &c.) and it is difficult to explain how they could entirely escape the eyes of all former observers.

The three general characters which distinguish the PHÆODARIA easily and constantly from all the other Radiolaria are the following:—(1) the double membrane, a thick outer and a thin inner envelope, of the big central capsule; (2) its typical main-opening or astropyle, placed on the oral pole of the main axis, and distinguished by a peculiar radiate operculum, with tubular proboscis; (3) the phæodium, or the peculiar voluminous pigment-body, which constantly lies in the oral half of the calymma, surrounds the oral part of the central capsule, and is composed of numerous phæodella, or singular pigment-granules of green, olive, brown or black colour.

Besides these three general and never failing marks of the PHÆODARIA, the majority of this legion (but by no means all) possess the three following peculiarities; (1) two parapylæ or accessory openings of the central capsule, placed laterally (at the right and left) on the aboral pole of the main axis (wanting in the Challengerida, Medusettida, Castanellida, and perhaps in some other families); (2) a characteristic skeleton which is always extracapsular, wanting only in the Phæodinida, incomplete in the Cannorrhaphida and Aulacanthida, but perfectly developed and of very various shapes in the twelve other families; usually this silicated skeleton is composed of hollow tubules, which are filled up by jelly (PANSOLENIA); but in some families it is composed of ordinary solid network, not different from that of the other Radiolaria, *e.g.*, especially in the Castanellida and Sagosphærida; (3) an extraordinary size of the body, as well of the central capsule and its nucleus, as of the extracapsular skeleton; the majority of PHÆODARIA have a diameter of 1 to 2 mm., and are therefore from ten to twenty times as large as the

majority of the other Radiolaria; in some gigantic forms the diameter of the unicellular body reaches 20 or even 30 mm.

*The Central Capsule* of the PHÆODARIA is the most important part of their body and preserves in all families of this legion the same essential structure, and nearly the same form, in striking contrast to the extraordinary variety and complication of the skeleton. As already mentioned, it differs from the central capsule of all the other Radiolaria in two most important peculiarities; firstly, the double membrane of the spheroidal capsule, and secondly, the singular structure of its constant main-opening, the astropyle. A third constant character is the considerable size of the enclosed nucleus, the diameter of which usually equals about half of that of the capsule itself.

The diameter of the capsule is, in the majority of PHÆODARIA, 0·1 to 0·2 mm., often also 0·3 to 0·4, rarely more than 0·5, or less than 0·05 mm.

The position of the central capsule is somewhat different in the four orders into which we have divided the PHÆODARIA. It lies in the centre of the spherical, concentric calymma in all the Phæocystina, or in those PHÆODARIA which possess no complete lattice-shell—Phæodinida, Cannorrhaphida, and Aulacanthida (Pls. 101–105). The Phæosphæria (comprising the Orosphærida, Sagosphærida, Aulosphærida, and Cannosphærida, Pls. 106–112) all possess a very big, usually spherical lattice-shell, and here the central capsule is much smaller than the latter and lies in its centre. Another position is constantly occupied by the central capsule in all Phæogromia (Pls. 99, 100, 113–120; the families Challengerida, Medusettida, Castanellida, Circoporida, Tuscarorida), which have a peculiar mouth on the lattice-shell, placed on the oral pole of its main axis; the central capsule lies in the opposite aboral half of the shell cavity. The Phæoconchia finally (Pls. 121–128, the families Concharida, Cœlodendrida, and Cœlographida) all possess a bivalved shell, and the capsule is here enclosed between the two valves of the shell.

The form of the central capsule is constantly spheroidal, slightly depressed in the direction of the main axis, and therefore comparable to the spheroidal form of our globe. The depression is generally very slight, so that the proportion of the minor vertical main axis to the major horizontal or equatorial axis is about 4 : 5 or 5 : 6, often even 8 : 9 or less; but sometimes the proportion becomes 3 : 4, or even 2 : 3, so that the capsule becomes nearly lenticular; very rarely its form becomes almost perfectly spherical (Pl. 101, fig. 1). The main axis stands always vertically, and is distinctly marked by the peculiar shape of the astropyle, placed on its oral pole. Usually this pole, in the living and freely floating PHÆODARIA seems to be the lower pole, directed downwards (as also in the NASSELLARIA); but in some families it seems to be inversely directed upwards, as in the Challengerida and Tuscarorida (Pls. 99, 100).

The two *membranes of the central capsule* possess in all PHÆODARIA a very different shape, and were in all preparations which I could accurately examine (some hundreds

belonging to all families) separated by a clear, rather wide interval, filled up either by a colourless fluid or by a structureless jelly (Pl. 103, fig. 1; Pl. 123, figs. 8, 9, &c.). They are in direct connection only at the openings. In the living PHÆODARIA, however, their distance is very small, or they are in immediate contact without any interval (Pl. 101, fig. 10; Pl. 102, fig. 1). According to the observations of Hertwig, the two membranes are always in close contact, and without interspace, in the living PHÆODARIA; and the space between them is an artificial product due to the influence of the preserving fluid or of certain chemical agents. In every case it is very easy to separate both membranes completely, except at the openings, where they are in direct connection. We distinguish both membranes shortly as ectocapsa and endocapsa.

The ectocapsa, or the outer membrane of the central capsule, is rather firm and durable, double-contoured, elastic and difficult to destroy. Its physical and chemical qualities seem to approach those of chitin. It becomes, however, stained red by carmine, and yellow by nitric acid. Usually it appears structureless and refracts the light strongly. In a few cases, however, it exhibits, when examined by strong lenses, a fine punctation; and in some Aulacanthida (especially in some big forms of *Aulographis* and *Aulospathis*) the entire ectocapsa was densely covered with peculiar curved, or S-shaped dark corpuscles (Pl. 114, fig. 13). They were all of the same length, about 0·01, and seemed to lie on its inner face.

The endocapsa, or the inner membrane of the central capsule, is much thinner than the outer, with which it is in immediate connection only at the openings. It encloses the entire contents of the capsule, and becomes very distinct, as soon as the latter are dissolved by chemical agents, or stained by carmine. In the majority of well-preserved preparations it is irregularly plicated, and resembles a thin, but firm, crumpled paper. Isolated pieces of the endocapsa are completely structureless, but exhibit also a considerable resistance, in spite of their minute thickness.

The openings of the central capsule exhibit in the PHÆODARIA a greater variety than their discoverer, R. Hertwig, supposed. The majority of the legion, certainly, possess the three openings described by him, and are therefore true TRIPYLEA. Some families, however, have only one opening, the astropyle, which is generally present (Challengerida, Medusettida, Castanellida, and *Phæocolla* among the Phæodinida, Pl. 101, fig. 1). In some other families there is a variable number of accessory openings or parapylæ, one, three, or more, *e.g.*, especially in the Circoporida and Tuscarorida. The former may be called Astropylea, the latter Sporopylea. Thus only a single opening to the central capsule is constant in all PHÆODARIA without exception, and that is the astropyle, or the large main-opening with its peculiar structure.

The astropyle, or the single constant main-opening of the central capsule, is distinguished by a very remarkable structure, and is sufficient of itself to separate the

PHÆODARIA from all the other Radiolaria, and from the other Rhizopoda in general. It is always placed on the oral pole of the main axis, forming here a peculiar cap-shaped or flatly conical elevation, the centre of which is prolonged into a short, cylindrical tubule; we call the latter shortly a proboscis, and the former an operculum. To understand better the different forms which these important parts assume in the different families, compare Pl. **101**, figs. 1–6; Pl. **102**, fig. 1; Pl. **103**, fig. 1; Pl. **104**, figs. 1–3; Pl. **111**, fig. 2; Pl. **123**, figs. 1–9; Pl. **127**, figs. 4–6; Pl. **128**, fig. 2, &c. Compare also the first very accurate figures which R. Hertwig has given in 1879 (*loc. cit.*) in his Taf. x.

The operculum of the astropyle, the most important part of this main opening ("der Oeffnungshof der Hauptöffnung," in the description of Hertwig), is a circular convex plate, always more strongly vaulted than the surrounding part of the capsule membrane, and is sharply separated from it by a circular, often thickened and double-contoured margin. The operculum covers the main-opening like the lid of a tea-kettle, and the proboscis arising from its centre is comparable to the handle of that lid. The diameter of the circular operculum is usually about half as long (rarely as long) as the radius of the central capsule, therefore in the majority of PHÆODARIA 0·03 to 0·06, sometimes 0·1 and more. Its form is sometimes more conical, sometimes more like a mamma. Its height is usually about equal to half its diameter. It always exhibits a very distinct radial striation, produced by numerous prominent radial ribs, which arise in the centre and end at the circular sharply truncated margin. The usual number of these radial ribs may be, in the operculum of smaller capsules, from thirty to fifty, in those of medium size from sixty to ninety, and in the largest two hundred to three hundred or more. Usually the ribs are simple (Pl. **101**, figs. 1, 2, 6, 10; Pl. **127**, figs. 4–6; also in all figures given by Hertwig); but sometimes, mainly in the biggest Aulacanthida, they are distinctly branched in a centrifugal direction (Pl. **114**, fig. 13; Pl. **115**, fig. 3). Hertwig is of the opinion that the radial ribs are thickened ridges of the endocapsa ("leistenartige Verdickungen der inneren Membran"), and that the ectocapsa covering it is structureless (compare his figs. 1 and 1*a*, in Taf. x.). But I am convinced now, by numerous experiments and observations, that the radiate operculum is a part of the outer, not of the inner membrane. That part of the latter which lies immediately beyond the former, and which may be called the "inner operculum," also exhibits usually a fine radial striation; but this is probably only the cast of the stronger and much more prominent radial ribbing of the "outer operculum" belonging to the ectocapsa. The latter exhibits a large circular opening with thickened margin, when the radiate operculum is taken from it. The operculum becomes stained intensely red by carmine, yellow by nitric acid, corresponding to the ectocapsa, the main-opening of which is closed by it.

The proboscis, or the cylindrical tubule, which arises in the centre of the

operculum, is often rather short, and bears the same relation to it as the nipple does to the human breast (Pl. 104, fig. 2). But usually it is more or less prolonged and often about as long as the radius of the capsule, rarely nearly as long as its diameter (Pl. 101, fig. 1). Its form is usually a slender cylinder, sometimes somewhat conical and tapering towards the distal end. It is more or less curved or S-shaped in the majority of preparations (Pl. 115, fig. 3; Pl. 127, fig. 6, &c.). Its thin wall is a direct prolongation of the outer membrane of the capsule, therefore it appears as a direct apophysis of the operculum, when this is detached from the latter. The opening at the distal end of the proboscis, through which the endosarc is thrown out, is circular.

The parapylæ, or the accessory openings of the central capsule, exhibit in all PHÆODARIA the same form and structure, but vary in number and disposition. They are recognised with difficulty in the smaller species, since they are always of small size, and may be easily overlooked. They seem to be completely wanting in the following families:—Challengerida (Pl. 99), Medusettida (Pls. 118–120), Castanellida (Pl. 113), and in single genera of other families, as in *Phæocolla* (Pl. 101, fig. 1). The majority of PHÆODARIA seem to possess the two lateral parapylæ, first described by Hertwig, placed at a variable distance on each side of the aboral pole, to the right and left (Pl. 101, figs. 2, 6, 10; Pl. 103, fig. 1*a*; Pl. 104, figs. 1, 2*a*; Pl. 123, figs. 1, 8*a*, &c.). The horizontal axis, in which the two parapylæ lie, is the frontal or lateral axis; and the plane, which passes through the three openings of these "Tripylea," is the frontal or lateral plane. The number of the parapylæ seems to be variable in the two families, Circoporida and Tuscarorida, which also differ from the other PHÆODARIA in the peculiar (porcellanous) structure of their shell-wall. The number seems to vary even in the single species of one genus; and the following cases may be found: (A) a single parapyle, placed on the aboral pole of the main axis and directly opposed to the astropyle (on the oral pole), as in *Tuscaridium* (Pl. 100, fig. 8); (B) three equidistant parapylæ, one of which is placed in the sagittal plane, and the two others one on each side of it, to the right and left, as in *Tuscarora* (Pl. 100, figs. 1–6); the three parapylæ seem to correspond here to the three long feet, or the tubular aboral apophyses of the shell, which are arranged in a similar manner to the three cortinar feet of the NASSELLARIA; (C) four equidistant parapylæ, placed in pairs on the poles of the diagonal axes of a horizontal plane, as in *Tuscarusa* (Pl. 100, fig. 7); they seem here to correspond to the four crossed aboral feet; (D) six to eight or more parapylæ, probably in the different genera of Circoporida (Pls. 114–117); perhaps each radial tube, which is surrounded on its base by a circle of pores, here corresponds to a separate parapyle. The number of well-preserved central capsules belonging to the two latter families, however, which I could examine was relatively small, and their examination very difficult; therefore these numbers are not stated with satisfactory certainty and require a further more accurate examination.

The minute structure of the parapylæ (or "Neben-Oeffnungen") has been described already very accurately by Hertwig (*loc. cit.*, p. 95, Taf. x. figs. 1–11*b*). The two membranes of the capsule are in direct and immediate connection on each parapyle. The strong outer membrane arises in the form of a ring or of a short cylindrical tubule (collare paraboscidis or "Oeffnungshals"), is then reflected inwards, and connected at the bottom of the cylindrical cavity with the delicate inner membrane. From this connective ring arises a short conical or cylindrical tubule, which we call shortly the "paraboscis." According to Hertwig (who calls it "Oeffnungskegel") the paraboscis is a direct prolongation of the inner membrane only. My own observations have led me to the opinion, that the paraboscis of each parapyle is a direct prolongation of the outer membrane (similarly to the larger proboscis of the astropyle), and that the basal connective ring is, therefore, the inner opening of the paraboscis, through which the entosarc enters, being protruded through its outer circular opening. Usually the paraboscis of each parapyle is only a short cylinder, arising by a conical base; but sometimes, especially in some Aulosphærida and Sagosphærida, it is prolonged into a slender tubule, nearly as long as the radius of the central capsule. It has been already figured by Hertwig (*loc. cit.*, Taf. x. figs. 6–8). It seems, therefore, that the paraboscis of the accessory openings is developed in a way similar to the proboscis of the main-opening, and that the chief difference between the two is indicated by the large radiate operculum of the latter.

The cavity of the endocapsa, or the spheroidal space enclosed by the inner membrane of the central capsule, is filled up in its central part by the big nucleus, in its peripheral part by the endoplasm, or by the internal protoplasm, which is in communication with the outer or extracapsular protoplasm by the openings of that capsule. The endoplasm, or the intracapsular sarcode, is rather opaque, finely granulated, and usually filled up by numerous small clear spherules of equal size, which are more or less regularly arranged and equidistant. These spherules have usually a diameter of 0·01 to 0·015, rarely more than 0·02 or less than 0·005 mm.; their size is generally equal in each capsule. They have been already described and figured in my Monograph, as "wasserhelle kugelige Bläschen," and are probably vacuoles or small vesicles filled up by jelly or by a clear fluid. Usually each vesicle contains a small dark granule of fat, or a group of such granules connected together; and in these Hertwig observed a vibrating molecular motion. The central capsule of many PHÆODARIA contains, besides the vacuoles, often granules of pigment (usually red or yellow) and sometimes numerous groups of small crystals, placed mainly beyond the operculum of the astropyle (Pl. 127, figs. 4–7). The outer layer of the endoplasm, placed immediately beyond the endocapsa, often exhibits a fine striation, as if composed of delicate fibrillæ. This fibrillar striation is usually most distinct on the base of the openings, where also the endoplasm becomes stained very intensely by carmine. The astropyle as well as

the parapylæ often exhibit here, when observed from the face, a distinct radial striation (compare Hertwig, *loc. cit.*, p. 98, Taf. x. figs. 6–14). Perhaps the radiate shape of the operculum is only produced by radial folds of the endocapsa placed beyond it, and these folds may be in turn the product of the radial fibrillæ, which are prominent beyond the astropyle. On the other hand, these fibrillæ may be compared to the muscular fibrillæ or "myophane filaments" in the ectosarc of the Infusoria, and may perhaps effect by their contraction a dilatation of the openings of the capsule.

The nucleus of the PHÆODARIA is always very large, usually about half or two-thirds as broad as the central capsule, and placed either in its centre, or sometimes nearer to one pole of the main axis, which is common to the capsule and its nucleus. Therefore the diameter of the latter is usually half or even two-thirds of that of the capsule, and may be in the majority 0·05 to 0·15, often 0·2 to 0·3, rarely more than 0·4 or less than 0·01 mm. The form of the nucleus is rarely spherical, usually spheroidal, and it is more depressed in the direction of the main axis than the capsule itself. In my Monograph, where I gave the first description of it, I called it "Binnenbläschen." The membrane of the vesicular nucleus is thin but rather firm, and contains a rather clear, finely granulated substance, in which numerous nucleoli are usually scattered. (Compare Pl. **101**, figs. 1–10; Pl. **102–104**; Pl. **123**; Pl. **127**, &c.; the nucleus is marked by *n*, the nucleoli by *l*.)

The nucleoli are very different in respect to their form, size, number and arrangement. Since these differences are very great even in different specimens of a single species (as, *e.g.*, in the common cosmopolitan *Aulacantha scolymantha*, *Aulosphæra trigonopa*, *Cœlodendrum ramosissimum*, &c.), it is probable that they represent different stages of development and multiplication, and that the smallest fragments of the nucleoli, or the final results of their repeated division, become the nuclei of the flagellate spores, which are developed in the PHÆODARIA just as in the other Radiolaria. In the majority of nuclei examined, the number of the enclosed nucleoli proved to be very great, fifty to eighty or more, often some hundreds, the greater their number the smaller their size. Their form is usually irregular, roundish, or even amœboid—probably the result of amœbiform motions (Pl. **101**, fig. 1). Sometimes the nucleoli were regularly spherical, equidistant, and connected apparently by a delicate network (Pl. **101**, fig. 2). (Compare Pl. **102–104**, **111**, **123**, and also Taf. x. of Hertwig, *loc. cit.*).

The calymma, or the extracapsular jelly-veil, is in the PHÆODARIA always well developed and usually much larger than the enclosed central capsule. The entire volume of the calymma may be three to six times as great as that of the capsule in the majority of this legion; but in the large Aulacanthida, Aulosphærida, Cœlodendrida, Cœlographida, &c., the volume of the former is twenty to fifty times as great as that of the latter, or even more. The jelly substance is rather firm and consistent, clear, structureless, and becomes more or less intensely stained by carmine. In the

larger forms it is often filled by numerous large alveoles, which are usually absent in the smaller forms. These extracapsular alveoles are most strongly developed in the calymma of the Phæocystina, or the PHÆODARIA with incomplete skeleton, embracing the three families Phæodinida, Cannorrhaphida and Aulacanthida (Pls. 101–104). Usually the calymma is here very voluminous and entirely filled up by large alveoles, which are either spherical, irregularly roundish, or polyhedral by mutual compression. These alveoles or vacuoles have no peculiar wall, but are only cavities in the homogeneous substance of the jelly, and are filled by a clear aqueous fluid. Between these the network of the anastomosing pseudopodia is expanded. They exhibit, therefore, the same shape, as was first observed in *Thalassicolla* and in the Polycyttaria (Collozoida, Sphærozoida and Collosphærida).

The relation of the calymma to the skeleton is in the PHÆODARIA of the same importance as in the other Radiolaria, and we may also here distinguish a primary and a secondary calymma. The primary calymma is that on the surface of which at a certain period of life (in the "shell-building period") the fenestrated shell is secreted in the majority of PHÆODARIA. The secondary calymma, however, is formed after this period, and envelops the shell itself as well as its apophyses externally. Usually the entire skeleton seems to be enveloped by the secondary calymma.

The parts of the extracapsular body, which are enclosed in the gelatinous calymma, possess a peculiar importance in the PHÆODARIA; these are firstly the sarcomatrix and the pseudopodia arising from it, and secondly the phæodium. The sarcomatrix, or the layer of extracapsular sarcode (ectoplasm), which immediately surrounds the central capsule, is very thick and more strongly developed in all PHÆODARIA than in all other Radiolaria. Its extraordinary size has been already mentioned by Hertwig (1879, *loc. cit.*, p. 99). It is in direct connection with the intracapsular sarcode (or the endoplasm) only by the openings of the central capsule, and mainly by the astropyle. Very numerous radial pseudopodia arise everywhere from the sarcomatrix and run to the surface of the calymma, usually forming a rich network in it by means of numerous branches and anastomoses (compare Pl. 101–104). On the surface of the calymma the meshes of this network are very numerous, and there arise from its nodal points the terminal pseudopodia, which float freely in the surrounding water. The metamorphoses of this network of sarcode, the perpetual changes in the number and size of its meshes, and the movements of the sarcode streams as well as of the small granules running in it, are always very manifest in the PHÆODARIA and in the big forms of this legion (mainly in the Aulacanthida) they are better observed than in the majority of other Radiolaria. In many PHÆODARIA (and perhaps in all) a part of the pseudopodia seems to have undergone a local differentiation, for special physiological purposes; and Hertwig has described a peculiar conical contractile body, which arises in *Cœlodendrum* between the two parapylæ (*loc. cit.*, p. 100, fig. 3). Further examination

of these interesting organs in living PHÆODARIA is required. Usually the sarcode, issuing from the openings of the capsule, forms a stronger cylinder, with peculiar movements.

The phæodium, or the peculiar dark extracapsular pigment-body of the PHÆODARIA, is one of the most important and most characteristic parts of their organisation, and has induced me to derive their name from it; it is not less typical for the whole legion, than the astropyle with its radiate operculum and the proboscis; and both these important parts are always in direct topographical and physiological connection. Whilst I have missed the phæodium in no *Phæodarium* in which the soft body was well preserved, I have not found it in any other Radiolaria; for the similar extracapsular pigment bodies, which are found in some species of *Thalassicolla* and some other Sphærellaria, have a composition and signification different from that of the phæodium—an exclusive peculiarity of the PHÆODARIA.

The typical importance of the phæodium for all members of this legion is proved by the following five facts:—(1) its constant presence in all PHÆODARIA; (2) its constant excentric position in the oral half of the calymma; (3) its constant relation to the astropyle, the operculum and the proboscis of which is always surrounded by it; (4) its constant considerable size, its volume being usually greater than that of the central capsule, the aboral half of which is covered by it; (5) its constant colour and morphological as well as chemical composition. These five facts together demonstrate by their absolute constancy the high morphological and physiological importance of the phæodium for this peculiar subclass of Radiolaria, although its true nature is difficult to make out, and its main function is not yet sufficiently known.

The first remarks that have been made on the phæodium were published in 1862 in my Monograph, where I noticed the peculiar dark brown extracapsular pigment body and its excentric position covering only one-half of the central capsule, in *Aulacantha* (p. 263, Taf. ii. figs. 1, 2), in *Thalassoplancta* (p. 262, Taf. iii. fig. 10), and in *Cœlodendrum* (p. 361, Taf. xxxii. fig. 1). Its general presence and peculiar composition were first recognised by Dr. John Murray, who had, during the Challenger Expedition, the first opportunity of examining many big living PHÆODARIA brought up from great depths. He gives in his first Report (1876, *loc. cit.*, p. 536), the following important notice:—"The sarcode of all these deep-sea Rhizopods has many large black-brown pigment-cells. Small bioplasts are scattered through the sarcode. These collect into capsular-like clumps when the animal is at rest, and are quickly coloured by carmine." In 1877 Dr. John Murray sent me the wonderful collection of PHÆODARIA brought home by the Challenger, and I had now the best opportunity for examining the phæodium in hundreds of well-preserved specimens. Supported by these extensive observations, I gave, in 1879, in a preliminary paper,[1] a fuller description of the

[1] Ueber die Phæodarien, eine neue Gruppe kieselschaliger mariner Rhizopoden, *Sitzungsb. med.-nat. Gesellsch. Jena*, December 12, 1879, pp. 3, 4.

phæodium, and of the phæodella (or the peculiar dark pigment-granules composing it). At the same time R. Hertwig published his observations on the big living TRIPYLEA examined by him at Messina, and pointed out particularly that the constant presence, composition, and arrangement of this excentric extracapsular pigment-body was most characteristic, and sufficient in itself to distinguish this group from all the other Radiolaria (1879, *loc. cit.*, p. 99).

The most striking peculiarity of the phæodium, and the most important on account of its absolute constancy, is its excentric position, covering only the oral hemisphere of the central capsule, and wholly or partly wanting on the aboral hemisphere. This constant topographical relation to the capsule never fails, and may be always observed at the first glance, when the body is seen from the side (the main axis of the capsule being perpendicular to the axis of the eye of the observer), (compare Pl. 101, figs. 6, 10; Pl. 102, fig. 1; Pl. 103, fig. 1, &c.). The phæodium envelops, therefore, the oral half of the capsule completely, and especially the astropyle in its centre; hence, the radiate operculum and the proboscis arising from the latter cannot be seen usually before the former is removed. The general form of the entire phæodium, in consequence of this excentric position, is concavo-convex (or crescentic in longitudinal section), its concave face embracing the oral or anterior face of the capsule, and its convex face being turned to the surface of the calymma.

The topographical relation of the phæodium to the surrounding shell is also very characteristic in the suborder Phæogromia, or in those PHÆODARIA which possess a peculiar shell-mouth placed on the oral pole of its main axis. Here the capsule is always placed in the aboral half of the shell-cavity, the phæodium in its oral half, separating the astropyle from the mouth of the shell, both of which lie in the main axis; as in the Challengerida (Pl. 99), Tuscarorida (Pl. 100), Castanellida (Pl. 113), Circoporida (Pl. 115), and Medusettida (Pl. 118–120). In this suborder (the Phæogromia), the volume of the phæodium may be, on an average, about as great as that of the central capsule, whilst in the majority of other PHÆODARIA it is much greater than the latter.

A similar topographical relation between the phæodium and the enclosing shell, as in the Phæogromia, also exists in the suborder Phæoconchia, or in those PHÆODARIA, which are distinguished from all the others by the possession of a bivalved shell (Pl. 121–128). The two valves of this curious shell, which resembles that of the Brachiopoda, are dorsal and ventral, and the tripylean central capsule is always so placed between them that its two lateral parapylæ (right and left) lie in the frontal plane of the shell, where a large frontal fissure opens between the opposed margins of the two hemispherical or cap-shaped valves. The phæodium is also placed here on the oral half of the capsule and surrounds its astropyle; but it exhibits some differences in the three families of Phæoconchia.

The Concharida, the bivalved shell of which is simple, and without tubular apophyses (Pl. **123–125**), possess a relatively small central capsule, which usually fills up only the third or fourth part of the shell-cavity. This is the aboral or posterior part, on the apex of which both valves are united by a ligament in some Concharida (Pl. **123**, figs. 8, 9). The oral or anterior part of the shell-cavity (usually two-thirds or more) is filled up by the phæodium, and this is usually bifid, being divided by a frontal constriction into two wings or lobes; the dorsal wing is hidden in the upper valve of the shell, the ventral wing in the lower valve; both wings are usually united only by a small central bridge, and this bridge of the phæodium is pierced in its centre by the proboscis of the astropyle (Pl. **124**, figs. 6, 10; Pl. **123**, figs. 8, 9).

The Cœlodendrida have a different shape (Pl. **121**). Their bivalved shell is relatively small and tiny, and bears on the two poles of the sagittal axis two conical apophyses or galeæ, from each of which three or four very large, dichotomously branched tubes arise. The central capsule fills up the cavity of the bivalved shell almost entirely, and the voluminous dark phæodium envelops both to such an extent that the shell and the enclosed capsule are often hidden in it completely. Therefore I arrived in my first description of *Cœlodendrum* (1862, *loc. cit.*) at the erroneous conclusion that the capsule lies outside, not inside the shell. The first accurate figure and description of its structure was given in 1879, by Hertwig (*loc. cit.*, p. 99, Taf. x. fig. 3). The central capsule (*v*) is here separated from the bivalved shell (*m*) only by a very small distance, and the oral part of both is hidden in the phæodium. I find, however, in the majority of the numerous preparations of the Challenger collection, the volume of the phæodium much greater, and it often envelops the entire shell.

The Cœlographida, finally, have a phæodium of the most remarkable shape, since in their bivalved shell a peculiar reserve store or magazine of phæodella, which we call the "phæocapsa" is developed for it (Pl. **126–128**, *g.t.m.*). The bivalved shell has in these most perfect PHÆODARIA a structure similar to that in the Cœlodendrida; but they differ from the latter in the stronger development, and greater differentiation of the two apical galeæ, and the large hollow tubes arising from them. These two helmet-shaped cupolæ, the galeæ (*g*), which arise from the two valves on the poles of the sagittal axis, are in the Cœlographida usually larger than the valves themselves, and are not closed, as in the Cœlodendrida, but open by a tubular apophysis at their base, the nasal tube or rhinocanna (*t*). The apex of the galea is connected with the open mouth of the rhinocanna by a single or double frenulum (*b*). The two nasal tubes or rhinocannæ (a dorsal and a ventral) lie in the sagittal plane of the body (and run from the base of each galea along the anterior convexity of the valve to its oral margin. Here is placed the proboscis of the astropyle, between the two opposed mouths of the rhinocannæ (Pl. **128**, fig. 2). The phæodium is usually hidden entirely

in the two phæocapsæ, which are composed of the two galeæ (*g*), and the two rhinocannæ arising from them (Pl. 127, figs. 4–9). A part of the phæodella is usually thrown out by the mouth of the latter (*m*).

The characteristic colour of the phæodium exhibits numerous different tints between green, brown, and black. It seems to be in the majority blackish-brown or greenish-brown, very often olive, more rarely almost quite green or red-brown. Usually the colour is so dark, intense and opaque, that the parts enclosed by the phæodium, mainly the oral hemisphere of the central capsule and the astropyle, are completely hidden in it. The chemical composition of the phæodium demands further accurate researches; unfortunately I have not been able to make out its true nature, since numerous different experiments furnished no certain general results.

The phæodella, or the pigment-corpuscles, which compose the phæodium, aggregated in hundreds, and in the bigger species in thousands, are usually spherical, sometimes somewhat ellipsoidal, at other times spheroidal or lenticular; but usually numerous smaller, irregular, roundish particles are intermingled between the larger and more regular corpuscles, and often the main mass forms a very fine black powder. The size of the phæodella is very variable, not only in the different species, but also in one and the same individual. The larger phæodella have a diameter of 0·01 to 0·02, the smaller of 0·004 to 0·008 mm.; but there also occur very big forms of 0·04 to 0·05 mm., or even more, and very small ones of 0·001 mm. or less. Usually the phæodium appears as an aggregate of numerous larger and smaller phæodella, which are very different in size as well as in the intensity and tint of their colour, and are irregularly crowded in a black, powder-like substance.

The morphological nature of the phæodella is also difficult to make out. I have already pointed out in my first description of *Aulacantha*, *Thalassoplancta* and *Cœlodendrum* (1862, *loc. cit.*), that a great part of these pigment-corpuscles are true cells, composed of a nucleus and protoplasm, which contains granules of pigment, and is enveloped by a membrane. Dr. John Murray, who had during the Challenger voyage the opportunity of examining numerous different living PHÆODARIA, and staining them by carmine, also asserts that a great part of those dark corpuscles are "large black-brown pigment-cells" (1876, *loc. cit.*, p. 536). Numerous preparations of the Challenger collection, well preserved in glycerine, and stained by carmine, contain PHÆODARIA belonging to different families, the phæodium of which contains numerous such "pigment-cells," with a dark red nucleus, and so similar are these cells, that every histologist should recognise them. But in strange contrast to this is the fact, that in numerous other mountings, prepared in the same manner, not a single cell of this kind is found in the phæodium, and that the latter is composed only of irregular pigment-granules. In many PHÆODARIA belonging to different families I, like Hertwig, could not find a single true nucleated cell in the phæodium.

A great part of the PHÆODARIA, and usually the bigger forms of Aulacanthida, Cannorrhaphida, Cœlodendrida, Cœlographida, &c., exhibit a peculiar structure of the larger phæodella, viz., a fine parallel striation (Pl. 101, figs. 3, 6; Pl. 102, fig. 1; Pl. 103, fig. 1; Pl. 104, figs. 1–3, &c.). In each phæodellum may be counted about ten to twenty such fine parallel stripes (more in the greater, less in the smaller forms); and in the ellipsoidal phæodella the stripes are either transverse rings, perpendicular to their main axis, or ascending obliquely; they often resemble the convoluted spiral filament of a thread-cell or nettle-cell of an Acaleph. Sometimes these parallel transverse stripes are very striking. Another structure is seen in larger phæodella, namely an aggregate or cluster of smaller globules, often of equal size, resembling a small morula. All these minute structures of the phæodella as well as their changes in the living PHÆODARIA, require a far more extensive examination (by means of strong lenses and different chemical reagents), than I could, unfortunately, devote to them.

The physiological signification of the phæodella, therefore, is at present not yet known; but the general facts quoted above, their constant presence, position, volume, and composition, make it probable that their physiological value in the PHÆODARIAN organism is very great. The following hypotheses may be taken provisionally into consideration:—A. The phæodella are peculiar symbiontes, or unicellular algæ, comparable to the xanthellæ or zooxanthellæ of the other Radiolaria. This hypothesis is probably correct for those phæodella which are true nucleated cells; and the more so, as the majority of PHÆODARIA do not exhibit those common yellow xanthellæ, which are usually found in the SPUMELLARIA and NASSELLARIA. It is even possible that the latter are absent in all PHÆODARIA. B. The phæodella are dark pigment-bodies, which absorb light and heat in a manner similar to the simple "pigment-eyes" of many lower animals, and may therefore be optical sense-organs of the PHÆODARIA. This hypothesis may be supported by a comparison with the large-eyed unicellular Protist, *Erythropsis agilis*, described by R. Hertwig. C. The phæodella are organs of nutrition of the PHÆODARIA and active in their metastasis ("Stoffwechsel"). Regarding them from this point of view, we may suppose that the phæodella are secreted products which serve for digestion, acting like the bile or the saliva of higher animals. Perhaps they too act like the venomous matter produced in the thread-capsules of the Acalephæ. The suggestion that they are mere excretions, or half-digested matters, as Hertwig supposes ("halb assimilirte Nahrungs-bestandtheile," 1879, *loc. cit.*, p. 99) seems less probable. The most important fact illustrating their high signification for the processes of nutrition, digestion and for effecting changes on matter, seems to be the close relation of the phæodium to the astropyle; the radiate operculum of the latter, and the proboscis arising from it, being constantly covered and completely hidden by the central main mass of the phæodium.

The skeleton of the PHÆODARIA is always extracapsular, and exhibits in the majority of this legion such a characteristic shape, form, and structure, that these organisms may be easily recognised by it, even apart from the central capsule and the phæodium. In a few cases, however, the skeleton is so similar to that of some NASSELLARIA and SPUMELLARIA, that it may be accidentally confounded with it. In general the skeleton of the PHÆODARIA is much larger, and much more highly developed, than that of most other Radiolaria, and exhibits the most wonderful appearances, and the most marvellous complications, which are found in the whole world of Protists, or of unicellular organisms. The varied composition and differentiation of the skeleton alone distinguishes the numerous families, genera, and species of PHÆODARIA described in the sequel; all the fifteen families, however, agree so completely in the structure of the central capsule and the phæodium described, that we may derive them all phylogenetically from a small skeletonless family, the Phæodinida.

The chemical composition of the skeleton seems to be, in the majority of PHÆODARIA, somewhat different from that of the other Radiolaria. In a few groups only, especially in the Cannobelida (*Dictyocha*, *Mesocena*, &c.), and in a part of the Castanellida and Concharida, the substance of the skeleton seems to be of pure silica, as in the NASSELLARIA and SPUMELLARIA; these flinty skeletons, therefore, may be also found fossil. In the majority of PHÆODARIA, however, the skeleton does not consist of pure silica, but of an organic silicate; it becomes more or less intensely stained by carmine, and browned or blacked by fire; in many cases it even becomes completely burned and destroyed by the prolonged action of heat. This circumstance explains why PHÆODARIA in general are rare in deep-sea deposits, as in the common Radiolarian ooze of the Pacific, and why they are generally absent in fossil deposits. Even the pure Radiolarian rocks of the Barbados, &c., contain only a few PHÆODARIA, mainly Dictyochida.

According to the different forms of the skeleton, we may divide the legion or subclass of PHÆODARIA into two sublegions, four orders, and fifteen families. Firstly, we may distinguish as two groups the Phæocystina, without a lattice-shell, and the Phæocoscina, with a lattice-shell (compare above, p. 5). The Phæocystina comprise three different families, viz., (1) Phæodinida, without any skeleton (Pl. 101, figs. 1, 2); (2) Cannorrhaphida, with an incomplete skeleton, composed of numerous separate, not radial pieces, which are scattered around the capsule in the calymma (Pl. 101, figs. 3–14; Pl. 114, figs. 7–13), and (3) Aulacanthida (Pl. 102–105), with an incomplete skeleton, composed of numerous hollow radial tubes, which pierce the calymma and come in contact by their proximal ends with the surface of the central capsule.

The Phæocoscina, or the PHÆODARIA with a lattice-shell (embracing the great majority of the whole legion) exhibit three principal differences in the shape of their shell, and from these we distinguish the three following orders; (A) Phæosphæria, with a spherical, not bivalved shell (rarely of an ellipsoidal or lenticular, or another

modified form), without a shell-mouth or a peculiar constant large opening on the lattice-shell; (B) Phæogromia, with an ovate or polyhedral, not bivalved shell (often also of a subspherical, ellipsoidal, or another modified form), constantly provided with a shell-mouth or a peculiar large opening on one pole of the main axis of the lattice-shell; (C) Phæoconchia, with a bivalved shell, composed of two completely separated, hemispherical, cap-shaped or boat-shaped valves (a dorsal and a ventral), comparable to that of the Brachiopoda.

The Phæosphæria, or those PHÆODARIA the big shell of which is usually spherical, never bivalved and never provided with a peculiar shell-mouth, comprise a great number of common and large-sized PHÆODARIA, which may be arranged into four different families, according to the different structure of the shell—(1) Orosphærida (Pl. 106, 107), spherical shell extremely big and robust, composed of a single piece of coarse lattice-work, the thick bars of which are stratified and contain partly a fine axial-canal, meshes of the network usually irregularly polygonal, no astral septa in the nodal points; (2) Sagosphærida (Pl. 108), spherical shell large-sized, but extremely delicate and fragile, composed of a single piece of arachnoidal lattice-work, the thin bars of which are simple solid threads, without axial-canal, meshes of the network always large and triangular, no astral septa in the nodal points; (3) Aulosphærida (Pl. 109–111), spherical shell large-sized, but very fragile, composed of numerous hollow cylindrical tubes, which are connected (and at the same time separated) by peculiar astral septa in the nodal points, meshes either triangular or polygonal; (4) Cannosphærida (Pl. 112), spherical shell double, composed of two concentric shells which are connected by thin hollow radial tubes, the inner shell simple, solid or fenestrated, with a shell-mouth on the basal pole, the outer shell composed of hollow cylindrical tubes which are connected by astral septa in the nodal points. The structure of this outer shell is the same as in the Aulosphærida, while the basal mouth of the inner shell brings this family in closer relationship to the Phæogromia.

The Phæogromia, or those PHÆODARIA the shell of which is not bivalved, but provided with a peculiar constant mouth on the oral pole of the main axis, are in general similar to the NASSELLARIA (Monocyrtida), and may be divided into five different families, viz., (1) Challengerida (Pl. 99), shell ovate or subspherical, also often triangular or lenticular, distinguished by a peculiar diatomaceous structure, an exceedingly fine tracery of regular hexagonal, very delicate network; (2) Medusettida (Pl. 118–120), shell ovate, campanulate or cap-shaped, distinguished by a peculiar alveolar structure, with a corona of peculiar hollow, large, articulated feet around the mouth; (3) Castanellida (Pl. 113), shell spherical or subspherical, of ordinary simple lattice-work, usually with a corona of simple solid teeth around the mouth; (4) Circoporida (Pl. 114–117), shell spherical or polyhedral, with panelled or dimpled surface, distinguished by a peculiar porcellanous structure (numerous thin needles being

embedded in a punctulate cement-substance), with hollow radial spines and with a corona of simple solid teeth around the mouth; (5) Tuscarorida (Pl. 100), shell ovate or subspherical, with smooth surface, of the same peculiar porcellanous structure as the Circoporida, but with hollow, very long, tubular teeth around the mouth.

The Phæoconchia are the peculiar and most interesting "PHÆODARIA bivalva," differing from all other PHÆODARIA, and from all known Radiolaria in general, in the possession of a bivalved lattice-shell, composed of a dorsal and a ventral valve. They may be divided into three families: (1) Concharida (Pl. 123–125), shell with two thick and firm, regularly latticed valves, which bear no hollow tubes and no cupola or galea on their apex or sagittal pole; (2) Cœlodendrida (Pl. 121), shell with two thin and fragile, scarcely latticed valves, which bear a conical cupola or a helmet-shaped galea on their apex, and hollow branched tubes arising from it (without rhinocanna and frenula); (3) Cœlographida (Pl. 122, 126–128), shell with two thin and fragile, scarcely latticed valves, similar to those of the Cœlodendrida, but differing from them in the development of a peculiar rhinocanna or nasal tube upon each valve; this tube is connected by an odd or paired frenulum with the apex of the galea, and both together contain the phæodium.

The phylogenetic affinity of the fifteen families enumerated, and the morphological relationship based upon it, form a very difficult problem. The whole legion of PHÆODARIA is probably monophyletic, in as much as all the families may be derived from a single ancestral group, the skeletonless Phæodinida (*Phæodina* and *Phæocolla*); but at the same time polyphyletic, in as much as probably many families have been derived, independently one from another, from different branches of Phæodinida; or in other words, the characteristic malacoma of the PHÆODARIA (the cannopylean central capsule and the calymma with the phæodium) may be a monophyletic product, inherited from a single ancestral form; the manifold skeleton, however, is certainly a polyphyletic product, originating from different skeletonless Phæodinida.

Among the independent families of PHÆODARIA, derived directly from skeletonless Phæodinida by production of a peculiar skeleton, may be the following: Cannorrhaphida (Pl. 101, probably polyphyletic) Aulacanthida (Pl. 102–105), Castanellida (Pl. 113), Challengerida (Pl. 99), Concharida (Pl. 123–125), Circoporida (Pl. 114–117) and Tuscarorida (Pl. 100). The four families of Phæosphæria (the Orosphærida, Sagosphærida, Aulosphærida and Cannosphærida (Pl. 106–112), may be derived perhaps from the Castanellida; and the Medusettida (Pl. 118–120), have been perhaps derived from the Challengerida. The complicated affinities of these groups are however difficult to explain. The Cœlodendrida (Pl. 121) are probably derived from the Concharida, and the Cœlographida (Pl. 126–128) from the Cœlodendrida.

The geometrical fundamental form of the shell is in the majority of PHÆODARIA monaxonial, corresponding to the main axis of the enclosed central capsule; the

astropyle of the latter, placed on the oral pole of the main axis, corresponds to the mouth of the shell in all Phæogromia. In the Phæosphæria, where no peculiar shell-mouth is developed, the general fundamental form of the shell is usually homaxonial or spherical, often an endospherical polyhedron, rarely ellipsoidal or spindle-shaped (with prolonged main axis), or lenticular (with shortened main axis). The bivalved Phæoconchia have usually either an amphithect shell (with the same fundamental form as the Ctenophora), or a dipleuric, bilaterally symmetrical shell (with a dorsal and a ventral valve, a right and a left parapyle). A small number of PHÆODARIA (mainly Circoporida) are remarkable on account of the regular polyhedral form of their shell, the geometrical axes of which resemble crystalline axes and are defined by regular radial tubes; as the octahedral *Circoporus* (Pl. 117, fig. 6), the dodecahedral *Circorrhegma* (fig. 2), and the icosahedral *Circogonia* (fig. 1).

The siliceous or silicate bars, which compose the skeleton of the PHÆODARIA, are in the majority hollow tubes, filled up by jelly; in some other families, however, they are solid rods, as in the NASSELLARIA and SPUMELLARIA. Such usual lattice-work, composed of solid rods, occurs only in the families Sagosphærida (Pl. 108), Castanellida (Pl. 113), and Concharida (Pls. 123–125). A quite peculiar structure, a diatomaceous tracery of extremely fine and regular hexagonal frames, distinguishes the Challengerida (Pl. 99). The hollow cylindrical tubes, which are found in the other families, appear in three different forms, simple, articulate, and provided with an axial thread. Simple hollow tubes, which are neither articulate, nor provided with an axial thread, occur in the Cannorrhaphida (Pl. 101) Aulacanthida (Pl. 102–105), Cœlodendrida (Pl. 121, 122), and Cœlographida (Pl. 126–128). In all these families the hollow cylindrical tubes have a very thin wall and contain a wide cavity, filled only by jelly. The Orosphærida (Pl. 106, 107), differ in the reduction of the cavity, which becomes very narrow (often rudimentary or lost), whilst the walls of the tubes become extremely thickened and stratified, numerous concentric layers of silica being disposed one over the other. The hollow cylindrical tubes contain an axial filament, or a thin thread of silica, placed in its axis, in the families Aulosphærida (Pl. 109–111), Cannosphærida (Pl. 112), Circoporida (Pl. 114–117), and Tuscarorida (Pl. 100). Usually the axial filament is connected with the thin wall of the tube by numerous horizontal branches. A quite peculiar structure distinguishes the Medusettida (Pl. 118–120); their hollow tubes, extremely prolonged, are articulate owing to the presence of numerous, regular, equidistant transverse septa; these are pierced by a short tubule, similar to the siphon of the shells of *Nautilus;* this remarkable alveolar structure also occurs in the peripheral part of their shell-wall (and sometimes in the whole shell), numerous small polyhedral chambers or alveoles which communicate by small openings, being developed; they become easily filled with air in the dry shell (Pl. 120, figs. 11–16).

The substance of the siliceous or silicated shell-wall is, in the majority of PHÆODARIA, homogeneous and structureless, as in the SPUMELLARIA and NASSELLARIA; but sometimes it acquires a peculiar structure. The thickened wall of the hollow tubes in the Orosphærida and in several Aulacanthida (Pl. 105, figs. 6–10) becomes distinctly stratified, concentric strata being disposed one over the other. A very remarkable structure, differing from that in all other Radiolaria, is found in the porcellanous shell of the Circoporida (Pl. 114–117), and Tuscarorida (Pl. 100). The thickened wall of the opaque shell is here composed of a peculiar silicated cement, which encloses numerous very thin and irregularly scattered needles (Pl. 115, figs. 6–9; Pl. 116, fig. 3). Dry fragments of these shells, observed by a strong lens, appear finely punctulate, and probably air, entering into these fine porules of the cement, causes the white colour and the calcareous or porcellanous appearance of the opaque dry shell. Its surface is smooth in the Tuscarorida (Pl. 100), panelled in the Circoporida (Pl. 114–117).

The hollow or solid spines, which arise from the shell of the PHÆODARIA, exhibit an extraordinary variety and elegance in the production of different branches, bristles, hairs, secondary spine, and thorns, hooks, anchor-threads, pencils, spathillæ, &c. These appendages are developed similarly to those of many SPUMELLARIA, but exhibit a far greater variety and richness in form. They are organs partly for protection, partly for retention of food. They are much more interesting than in other Radiolaria.

*Synopsis of the Orders and Families of* PHÆODARIA.

| | | | |
|---|---|---|---|
| I. Order PHÆOCYSTINA. Skeleton absent or incomplete, composed of numerous single scattered pieces, without connection. Central capsule placed in the centre of the calymma. | Skeleton completely absent, | | 1. PHÆODINIDA. |
| | Skeleton composed of numerous scattered pieces, not of radial tubes, | | 2. CANNORRHAPHIDA. |
| | Skeleton composed of numerous hollow radial tubes, the proximal ends of which are in contact with the central capsule, | | 3. AULACANTHIDA. |
| II. Order PHÆOSPHÆRIA. Skeleton a simple or double lattice-shell, not bivalved, without a peculiar shell-mouth (shell usually spherical, rarely of a modified form, always without peristome). Central capsule placed in the centre of the shell-cavity. | Shell composed of a simple, non-articulated lattice-plate, without astral septa in the nodal points. | Network very robust and coarse, with irregular polygonal meshes; bars very thick, partly hollow, | 4. OROSPHÆRIDA. |
| | | Network very delicate and fragile, with subregular, triangular meshes; rods very thin, filiform, always solid, | 5. SAGOSPHÆRIDA. |
| | Shell composed of numerous hollow, tangential cylindrical tubes, which are separated by astral septa in the nodal points. | Shell articulated, with astral septa, without a simple central shell, | 6. AULOSPHÆRIDA. |
| | | Shell double, composed of two concentric shells; the outer articulated, the inner simple, | 7. CANNOSPHÆRIDA. |

*Synopsis of the Orders and Families of* PHÆODARIA—*continued.*

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|---|---|---|---|
| III. Order PHÆOGROMIA. Skeleton a simple lattice-shell, not bivalved, constantly provided with a peculiar large shell-mouth placed on the oral pole of the main axis; peristome usually surrounded by peculiar feet or teeth. (Shell either spherical or ovate, or of another form). Central capsule excentric, placed in the aboral half of the shell-cavity. | Structure of the shell not porcellanous (without needles imbedded in a punctulate cement-substance). | Structure of the shell diatomaceous, with very delicate and regular hexagonal pores. No articulate feet, | 8. CHALLENGERIDA. |
| | | Structure of the shell alveolar, with hollow alveoles between a double plate. A corona of articulated feet around the mouth, | 9. MEDUSETTIDA. |
| | | Structure of the shell of simple lattice-work, neither diatomaceous nor alveolar. No articulate feet, | 10. CASTANELLIDA. |
| | Structure of the shell porcellanous, with peculiar fine needles imbedded in a punctulate cement-substance (a circle of pores around the base of each radial tube). | Surface of the shell panelled or dimpled (spherical or polyhedral). Peristome flat, | 11. CIRCOPORIDA. |
| | | Surface of the shell smooth, even (ovate or subspherical). Peristome prominent, | 12. TUSCARORIDA. |
| IV. Order PHÆOCONCHIA. Skeleton a bivalved lattice-shell, composed of a dorsal and a ventral valve which are completely separated (rarely connected by a ligament on the aboral pole). Central capsule enclosed between the two valves. | The two valves of the bivalved shell thick and firm, regularly latticed, without a galea or cupola on their apex, and without hollow tubes, | | 13. CONCHARIDA. |
| | The two valves of the bivalved shell very thin and fragile, scarcely latticed, each with a conical cupola or a helmet-shaped galea on its sagittal pole or apex, and with hollow tubes. | Galea without rhinocanna or nasal tube, without frenula, | 14. CŒLODENDRIDA. |
| | | Galea with a rhinocanna or nasal tube, both connected by an odd or paired frenulum, | 15. CŒLOGRAPHIDA. |

## Order I. PHÆOCYSTINA, Haeckel (1879).

*Definition.*—PHÆODARIA without lattice-shell, either without any skeleton, or with an incomplete skeleton, composed of numerous single pieces, which are scattered in the calymma without connection. Central capsule placed in the centre of the spherical calymma.

## Family LXXI. PHÆODINIDA, Haeckel (Pl. 101, figs. 1, 2).

*Phæodinida*, Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 4.

*Definition.*—PHÆODARIA without skeleton. Central capsule with one to three (or more) openings, placed in the centre of the spherical naked calymma.

The family Phæodinida is the simplest and most primitive of the PHÆODARIA, and differs from all the other families of this legion in the complete absence of a skeleton. It bears, therefore, the same relation to the latter as the Thalassicollida do to the other SPUMELLARIA. The soft body is only composed of the central capsule with the nucleus, and the calymma with the phæodium.

Of course it is quite possible that the skeletonless PHÆODARIA, which we regard here as the ancestral family of that legion, may be either members of other families which have lost their skeleton accidentally, or young PHÆODARIA which have not yet developed a skeleton. But in some preparations of the Challenger certain large, well-preserved PHÆODARIA, without any trace of skeleton, are not rare; and since I myself have observed a complete living *Phæodina*, I have no doubt that they are independent, primordial forms (like *Actissa*, *Thalassicolla*, *Cystidium*, *Nassella*, &c.). Probably also two skeletonless PHÆODARIA belong to this family which are figured by R. Hertwig, in 1879, in his Organismus d. Radiol. (Taf. x. fig. 1, 11); this author, however, supposed that they had lost their original skeleton.

The three species of Phæodinida which are described in the sequel represent two different genera, *Phæodina* and *Phæocolla*, already distinguished in my first note on the PHÆODARIA (Sitzungsb. med.-nat. Gesellsch. Jena, 1879, Dec. 12, p. 4). *Phæodina* is a true TRIPYLEA, and has the usual three openings which occur in the majority of PHÆODARIA, a large astropyle or main-opening on the oral pole of the main axis, and a pair of lateral accessory openings, or parapylæ, on the aboral pole. *Phæocolla*, however, has only a single opening, the astropyle, and agrees therefore with those PHÆODARIA which possess no parapylæ (Challengerida, Medusettida, Castanellida, &c.).

The complete body is in all observed Phæodinida a small jelly sphere of 1 to 3 mm. in diameter, with a transparent cortical layer and an opaque dark central part. This latter is the phæodium, in which the central capsule is hidden, surrounded on all sides by the gelatinous spherical calymma; the smooth surface of the latter is spherical.

The *central capsule* of the Phæodinida (Pl. 101, figs. 1, 2), is either spherical or spheroidal, somewhat lenticular, slightly depressed in the direction of the main axis. Its diameter is between 0·15 and 0·25. Its double membrane exhibits the same structure as in the other PHÆODARIA. The thick, double-contoured outer membrane is separated from the thin and delicate inner membrane by a clear space, filled up by jelly or by a fluid; the two are connected in *Phæocolla* (fig. 1) only at the astropyle, in *Phæodina* (fig. 2),

they are also connected at the two parapylæ. The radiate operculum of the astropyle opens by a tubular prolongation or proboscis, which is very long in the former, shorter in the latter. The two parapylæ of the latter also bear short tubules. The protoplasm, enclosed in the inner membrane, contains numerous small circular vacuoles. The large central nucleus is sometimes spherical or ellipsoidal, at other times spheroidal or lenticular; it always contains numerous nucleoli. One specimen observed, with two nuclei, was apparently engaged in self-division (fig. 2).

The spherical gelatinous calymma, in the centre of which the central capsule is placed, has a diameter of 1 to 2 mm. In the specimen of *Phæodina tripylea*, which I observed living, it exhibited exactly the same shape as the figure of *Dictyocha stapedia* in Pl. 101, fig. 10; the only distinction in this latter being indicated by the pileated pieces of the skeleton on the surface. The jelly-sphere contained numerous roundish or globular alveoles of very different sizes, and between them an areolated network of protoplasm; the latter has arisen from the outer surface of the calymma in the form of very numerous, radiating, partly branched and anastomosing pseudopodia. The dark and opaque centre of the jelly-sphere is filled up by the granular, blackish-brown phæodium, which envelops the oral half of the central capsule completely; it exhibits the same characters as in all the other PHÆODARIA.

*Synopsis of the Genera of Phæodinida.*

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| Central capsule with a single opening (an astropyle on the oral pole), . . . | 656. *Phæocolla.* |
| Central capsule with three openings (an oral astropyle and two aboral parapylæ), . | 657. *Phæodina.* |

Genus 656. *Phæocolla*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 4.

*Definition.*—Phæodinida with a single aperture to the central capsule (an astropyle with radiate operculum, placed on the oral pole of the main axis).

The genus *Phæocolla* may be regarded as the simplest form of all PHÆODARIA, and perhaps as the common ancestral form of this legion. It has no skeleton, and the central capsule exhibits only a single aperture on one pole of the main axis. In this it agrees with the Challengerida, Medusettida, and Castanellida, which have also no parapylæ or secondary openings.

1. *Phæocolla primordialis*, n. sp. (Pl. 101, fig. 1).

Central capsule subspherical, or somewhat depressed in the direction of the main axis. The oral pole of the latter exhibits a large astropyle, or a radiate operculum, about as broad as the

[1] *Phæocolla* = Brown jelly; φαιός, κόλλα.

nucleus. From its centre arises a conical mammilla, prolonged into a thin, cylindrical, S-like tubulus, the proboscis, which is about as long as the diameter of the capsule. The outer membrane of the capsule is thick and double-contoured; the inner is very thin, but distinct, and includes finely granulated protoplasm, and numerous spherical, clear vacuoles, each with some small granules. Nucleus spheroidal, depressed in the direction of the main axis, containing numerous dark, irregularly amœbiform nucleoli. The diameter of the nucleus is about equal to the radius of the central capsule. The extracapsular calymma is an alveolated sphere, the diameter of which is six to eight times that of the capsule. The inner part of it contains an irregular, blackish phæodium, which surrounds and hides the oral half of the central capsule.

*Dimensions.*—Diameter of the central capsule 0·16, of the nucleus 0·08, of the calymma 1·0 to 1·2.

*Habitat.*—Central Pacific, Station 271 to 274, surface.

## Genus 657. *Phæodina*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 4.

*Definition.*—Phæodinida with three apertures to the central capsule (an astropyle on the oral pole of the main axis, and two lateral parapylæ on both sides of the aboral pole).

The genus *Phæodina* has the same structure of the central capsule as the majority of PHÆODARIA; one large main-opening or astropyle on the oral pole of the main axis, and two smaller lateral accessory openings or parapylæ on each side of the aboral pole: it is therefore a true Tripylean genus, like the majority of PHÆODARIA.

### 1. *Phæodina tripylea*, Haeckel (Pl. 101, fig. 2).

? *Tripylea* sp., R. Hertwig, 1879, Organismus d. Radiol., Taf. x. figs. 1, 11.

Central capsule spheroidal or lenticular, somewhat depressed in the direction of the main axis. Astropyle with a strongly ribbed, radiate operculum, scarcely one-third as broad as the diameter of the capsule, and prolonged into a short tubular proboscis. Parapylæ also with short tubular openings. The outer strong (double-contoured) membrane of the central capsule is separated from the inner thin (simple-contoured) membrane by a wide interval, filled up by a clear fluid or jelly; only at the three apertures both membranes are in direct connection. The granulated protoplasm contains numerous vacuoles, and surrounds a large spheroidal nucleus, with numerous small nucleoli. The voluminous calymma in a specimen, observed living, was alveolar, and the ramification of the pseudopodia, as well as the formation of the dark brown phæodium, very similar to that of *Dictyocha stapedia* (Pl. 101, fig. 10). Another specimen, figured in Pl. 101, fig. 2, exhibited the first stages of self-division; the reticulated nucleus and the radiate operculum of the astropyle were already doubled, and the two membranes of the capsule between them constricted in the median plane. To this species belong probably the two central capsules figured by R. Hertwig, *loc. cit.*

[1] *Phæodina* = Provided with brown pigment; φαιώδιον.

*Dimensions.*—Diameter of the central capsule 0·15 to 0·25, of the nucleus 0·06 to 0·1, of the calymma 0·8 to 1·2.

*Habitat.*—Mediterranean; Portofino, near Genoa (Haeckel); Messina (Hertwig).

2. *Phæodina cannopylea*, n. sp.

Central capsule subspherical, scarcely depressed in the direction of the main axis. Astropyle with a finely ribbed radiate operculum, about as broad as the radius of the capsule, prolonged into a slender, tubular proboscis which is S-shaped, about as long as the radius, and similar to that of *Phæocolla primordialis*, Pl. **101**, fig. 1. Parapylæ also tubular, with two slender prolongations, half as long and broad as the proboscis of the parapyle. Nucleus spheroidal, about half as broad as the capsule. This species differs from the preceding mainly in the cylindrical slender prolongations of the three apertures, which are similar to those of *Aulosphæra* and *Aularia* (Pl. **111**, fig. 2).

*Dimensions.*—Diameter of the central capsule 0·2, of the nucleus 0·1, of the calymma 1·2 to 1·5.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Family LXXII. CANNORRHAPHIDA, Haeckel, 1879 (Pl. **101**, figs. 3–14; Pl. **114**, figs. 7–13).

*Cannorrhaphida*, Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 4.

*Definition.*—PHÆODARIA with an incomplete skeleton, composed of numerous separate, not radially arranged pieces, which are either hollow tangential spicula or cap-shaped dishes, or fenestrated rings, scattered loosely in the calymma. Central capsule placed in the centre of the spherical calymma.

The family Cannorrhaphida comprises those PHÆODARIA in which the incomplete skeleton is represented by numerous separate pieces of silica, which exhibit very different forms, and are scattered tangentially on the surface of the spherical calymma, sometimes also throughout its jelly-mass. They agree in this peculiar character with the Thalassosphærida (among the SPUMELLARIA) and bear the same relation to the skeleton-less Phæodinida as the Thalassosphærida do to the Thalassicollida (compare pp. 10 and 29). The Cannorrhaphida represent the former group among the PHÆODARIA. They differ from the following family, the Aulacanthida, in the arrangement and position of the hollow spicula, which are never directed radially and never touch the central capsule, as is constantly the case in the latter.

Two genera of Cannorrhaphida have been hitherto known. The first species observed in a complete and living state (at Messina in 1859) was *Cannobelos cavispicula*, described in 1862 in my Monograph as *Thalassoplancta cavispicula* (*loc. cit.*, p. 261, Taf. iii. figs. 10–13). I there figured a complete living specimen with expanded pseudopodia and a double central capsule (in the stage of self-division). The latter was surrounded by an

alveolar calymma and by a voluminous mass of blackish-brown pigment, the phæodium; numerous, long, hollow, cylindrical tubes were scattered on the surface of the calymma. At that time I did not know the tripylean character of the central capsule and the peculiar radiate operculum in the PHÆODARIA, and therefore placed *Thallassoplancta cavispicula* among the Thalassosphærida.

The second description of a complete form of Cannorrhaphida was given in 1879 by R. Hertwig, under the name *Dictyocha fibula* (Organismus d. Radiol., p. 89, Taf. ix. fig. 5). The genus *Dictyocha* had been already founded by Ehrenberg in 1838, with the following definition :—"Lorica simplex, univalvis, silicea, laxe reticulata aut stellata" (Abhandl. d. k. Akad. d. Wiss. Berlin, 1838, p. 128). Ehrenberg had found only scattered pieces of the skeleton, fossil in Tertiary rocks. He placed them among the *Bacillaria* (= *Diatomaceæ*), but added, that they may be possibly scattered spicula of Sponges ("forsan Spongiarum ossicula").

In 1859 I myself observed similar forms of *Dictyocha* at Messina, and first recognised them as true Radiolaria. But I placed them at that time among the Acanthodesmida, beside *Prismatium*, supposing that a small spherical body which I had sometimes seen in the cavity of the pileated pieces (probably a phæodellum) was the small central capsule (Monogr. d. Radiol., 1862, p. 271, Taf. xii. figs. 3–6). The complete body of *Dictyocha* was not described till 1879, when R. Hertwig gave a full description of its peculiar structure, and especially of the great central capsule, which resembles that of the other PHÆODARIA. He first stated that the singular pileated pieces described by Ehrenberg were not complete shells, but isolated pieces of the skeleton, which are scattered in the jelly-envelope around the central capsule in a mode similar to the spicula of *Thalassoplancta*, *Thalassosphæra* and *Sphærozoum*. Hertwig also first recognised that the thin rods, which compose the reticular pileated pieces of the skeleton in *Dictyocha*, are not solid bars, but thin hollow tubules, similar to the hollow rods of *Aulacantha* and of other PHÆODARIA.

Numerous complete and well-preserved specimens of *Dictyocha*, which I found in the collection of the Challenger, have convinced me that the accurate description of R. Hertwig is correct in every respect, and that these remarkable bodies are true PHÆODARIA, most closely allied to *Cannobelos* (= *Thalassoplancta*) and to *Aulacantha* (compare Pl. 101, fig. 10). I now regard them as representatives of a peculiar subfamily of Cannorrhaphida, which I call Dictyochida. To the same subfamily also belong the small annular bodies which Ehrenberg described in 1841 as *Mesocena* (*loc. cit.*, p. 401), and the elegant, more complicated, reticular and pileated bodies, which Stöhr figured in 1880 under the name *Distephanus* (Palæontogr., vol. xxvi. p. 121). These peculiar bodies are also only isolated pieces of the siliceous skeleton, and are scattered tangentially in great numbers in the calymma, around the tripylean central capsule. A still higher degree of development is attained by the interesting forms

which I describe here as *Cannopilus* (Pl. **114**, figs. 7–13). All these peculiar forms may be derived from the simple annular pieces of skeleton, which are aggregated in great numbers in the calymma of *Mesocena*. The pieces of the skeleton of these Dictyochida never assume the form of slender, cylindrical, tangential tubules which is characteristic of the Cannobelida.

A third subfamily of Cannorrhaphida, the Catinulida, is represented by the remarkable new genus *Catinulus* (Pl. **117**, fig. 8). The single pieces of the skeleton, scattered in hundreds or thousands throughout the calymma, are here not composed of hollow rods, as in the two former subfamilies, but are solid hemispherical caps, or small, more flatly vaulted dishes, with a peculiar radial striation. All the complete specimens of *Catinulus* which I could examine possessed four equal central capsules, united in one spherical calymma.

The common character which unites the three rather different subfamilies, the Cannobelida, Dictyochida and Catinulida, into a single family, and which separates this family, the Cannorrhaphida, from the other PHÆODARIA, is to be found in the composition of the rudimentary skeleton from numerous single pieces, which are loosely scattered either on the surface of the calymma, or throughout its jelly-mass, and which are never arranged radially, and never touch the central capsule, as is always the case in the closely allied Aulacanthida.

The slender spicula of the Cannobelida are cylindrical or spindle-shaped, tubular, scattered in variable numbers, but always in a tangential direction on the surface of the calymma. Usually they are 0·2 to 0·5 long, and 0·005 to 0·03 broad; either straight or slightly curved; smooth and simple in *Cannobelos*, spiny or branched in *Cannorrhaphis* (Pl. **101**, figs. 3–5). Their wall is thin and fragile, their diameter sometimes equal throughout their whole length, at other times tapering towards both ends. Their cavity is filled by jelly, and seems to be open at both ends, since the purified and dried spicula constantly become filled by air.

The peculiar pieces of silica which compose the skeleton of the Catinulida are not hollow, like the rods of the other Cannorrhaphida, but concave hemispherical cups or more flatly vaulted little dishes, the thin flinty wall of which is slightly thickened at the circular margin, and radially striped above it. In all three species of *Catinulus* observed they were scattered throughout the calymma in hundreds or thousands (Pl. **117**, fig. 8). Their relation to the Dictyochida is doubtful. Perhaps the small cups of *Catinulus* may be derived from the simple rings of *Mesocena*, by development of an operculum on one side of the ring.

The skeleton of the Dictyochida is much more developed and possesses a higher morphological interest; the numerous different forms, however, which its pieces here assume, may be all derived from the simple circular ring of *Mesocena*. This ring is formed by a thin, hollow, cylindrical, or prismatic rod, sometimes circular or elliptical, at

other times polygonal. From its margin small, hollow, radial spines often proceed (Pl. 101, fig. 9). In *Dictyocha* there arise from the ring two, three, four or more siliceous bars or arches, which form one or more bridges over one side of the ring; usually the little fenestrated shell thus produced assumes the form of a three-sided or four-sided pyramid, or of a little hat with three or four meshes (Pl. 101, figs. 10–14). From this *Dictyocha* (in a restricted sense) we separate the genus *Distephanus*, in which the little pyramids become truncated, so that one central apical mesh (the apical or upper ring) is surrounded by four, five, six or eight lateral meshes, the sides of the pyramid (Pl. 114, figs. 7–9). The edges of the small pyramid are formed by the same number of siliceous bars arising from the ring and alternating with the meshes. Radial spines in different numbers and arrangements arise from the corners of the two parallel rings, as well from the smaller apical as from the larger basal ring. The simple apical ring of *Distephanus* becomes divided or fenestrated in the highest developed genus of this subfamily, in *Cannopilus* (Pl. 114, figs. 10–13); each pileated piece of the skeleton exhibits here two rows of alternating lateral meshes, an upper row of smaller and a lower row of larger meshes.

The majority of Dictyochida are armed with spines or thorns, which arise in a regular manner from different points of the annular or pileated pieces. In the ancestral genus, *Mesocena*, radial spines start from the corners of the simple ring in centrifugal direction, and lie horizontally in its plane. As these primary corner-spines determine the radial composition of the more highly developed genera we call them perradial (lying in rays of the first order). In *Dictyocha* and *Distephanus* commonly (but not quite constantly) these perradial spines alternate with the ascending bars which bisect the sides of the basal ring; these bars are therefore interradial (lying in rays of the second order); consequently also the corners of the apical ring of *Distephanus* are interradial. The latter also often bear small thorns or teeth. Other teeth frequently start in centripetal direction from the lower or basal ring, on the side of the perradial spines, and frequently they are directed obliquely downwards.

In *Dictyocha* and *Distephanus* are frequently found remarkable twin pieces, composed of two pileated and reticulated skeleton pieces. These are united by their basal rings loosely in such a way that they form together a small fenestrated subspherical body; the union is strengthened by those small teeth of the basal rings, which are directed downwards and catch one into the other (Pl. 101, fig. 12; Pl. 114, fig. 8). A similar twin piece has been already observed by Stöhr in the fossil *Distephanus rotundus*, and upon this was founded this genus. Since the teeth of the two opposed basal rings, catching one into the other, seem to be specially adapted for the composition of those small double pyramids, it is probable that the latter possess a special protective function in these PHÆODARIA, and perhaps envelop their phæodella or their flagellate spores (?). In every case these formations are very remarkable.

*The Central Capsule* of the Cannorrhaphida seems to possess the same shape in the three subfamilies, and to agree in general with that of the Aulacanthida. In a living specimen of *Dictyocha stapedia*, which I observed at Ceylon (Pl. 101, fig. 10), the three openings of the TRIPYLEA were distinct; the radiate operculum of the astropyle (on the oral pole) was surrounded by the granules of the dark phæodium, whilst on the opposite aboral side, two parapylæ or conical secondary openings were visible. The voluminous spherical calymma (about four times as broad as the central capsule) contained numerous large alveoles (as in *Aulosphæra*) and its surface was protected by numerous pileated pieces of the skeleton; the basal ring of the latter was placed tangentially in the spherical surface of the calymma, their apical spine being directed outwards The pseudopodia, arising from the central capsule and forming a network between the alveoles of the calymma, radiated outwards in great number from its surface (Pl. 101, fig. 10).

The propagation by self-division seems to be very frequent in the Cannorrhaphida. I frequently found two equal central capsules in one calymma, as in the first observed species, *Cannobelos cavispicula*, and in *Cannorrhaphis spinulosa* (Pl. 101, fig. 3), sometimes also in *Dictyocha* and *Distephanus*. As already mentioned, *Catinulus* constantly exhibited four central capsules united in each calymma.

## *Synopsis of the Genera of Cannorrhaphida.*

| | | | |
|---|---|---|---|
| I. Subfamily Cannobelida. Pieces of the skeleton cylindrical or spindle-shaped tangential tubules. | Tubules simple, smooth, | | 658. *Cannobelos.* |
| | Tubules spiny or branched, | | 659. *Cannorrhaphis.* |
| II. Subfamily Catinulida. Pieces of the skeleton hemispherical or cap-shaped, solid. | Caps or hemispherical pieces of the skeleton solid, with radiate margin and circular opening, | | 660. *Catinulus.* |
| III. Subfamily Dictyochida. Pieces of the skeleton either simple rings or pileated or pyramidal bodies, composed of thin hollow rods and reticular meshes. | Flinty pieces simple or arched rings, not truncated pyramids, with a basal ring, but without apical ring. | Basal ring simple, not arched or fenestrated, | 661. *Mesocena.* |
| | | Basal ring fenestrated, with two or more arches, vaulted over one side, | 662. *Dictyocha.* |
| | Flinty pieces of the skeleton resembling a truncated pyramid, with an upper smaller apical ring, and a lower larger basal ring. | Apical ring simple, not fenestrated (one girdle of meshes on each piece), | 663. *Distephanus.* |
| | | Apical ring fenestrated (two girdles of meshes on each piece), | 664. *Cannopilus.* |

## Subfamily 1. CANNOBELIDA, Haeckel.

*Definition.*—Cannorrhaphida with numerous hollow cylindrical or spindle-shaped tubes, which lie tangentially scattered on the surface of the spherical calymma.

### Genus 658. *Cannobelos*,[1] n. gen.

*Definition.*—Cannorrhaphida with a skeleton composed of tubular acicular pieces, which are smooth, cylindrical or spindle-shaped tangential needles, without spines and branches.

The genus *Cannobelos*, and the following closely allied *Cannorrhaphis*, represent the peculiar subfamily Cannobelida, differing from the other Cannorrhaphida in the acicular form of the pieces of the skeleton, which are tangentially scattered on the surface of the spherical calymma. The cylindrical or spindle-shaped hollow needles are smooth in *Cannobelos*, whilst in *Cannorrhaphis* they are studded with lateral spines or branches.

#### 1. *Cannobelos cavispicula*, Haeckel.

*Thalassoplancta cavispicula*, Haeckel, 1862, Monogr. d. Radiol., p. 261, Taf. iii. figs. 10–13.
*Thalassicolla cavispicula*, Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 798.
*Cannorrhaphis cavispicula*, Haeckel, 1881, Prodromus, p. 470.

Tangential tubes cylindrical, more or less curved, gradually tapering towards the two pointed ends. Calymma with a voluminous phæodium.

*Dimensions.*—Length of the tubular spicule 0·25, breadth 0·003.

*Habitat.*—Mediterranean, Messina, surface.

#### 2. *Cannobelos calymmata*, n. sp.

Tangential tubes cylindrical, straight, of equal breadth throughout their whole length, closed by a hemispherical cap on the two rounded ends. Calymma very voluminous, with a small phæodium.

*Dimensions.*—Length of the tubular spicula 0·3 to 0·5, breadth 0·004 to 0·008.

*Habitat.*—Central Pacific, Stations 263 to 274, surface.

#### 3. *Cannobelos thalassoplancta*, n. sp.

Tangential tubes spindle-shaped, straight, gradually tapering towards the two pointed ends. Calymma and the included phæodium rather voluminous.

*Dimensions.*—Length of the tubular spicula 0·15 to 0·2, breadth in the middle part 0·02.

*Habitat.*—Tropical Atlantic, Station 347, surface.

[1] *Cannobelos* = Bearing hollow tubular arrows; κάννα, βέλος.

Genus 659. *Cannorrhaphis*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 4.

*Definition.*—Cannorrhaphida with a skeleton composed of tubular acicular pieces, which are spiny, cylindrical or spindle-shaped tangential needles, either with lateral spines or branches.

The genus *Cannorrhaphis* differs from the preceding closely allied *Cannobelos* in the spiny shape of the tangential acicular spicula, which are studded either with short spines or with longer lateral branches.

1. *Cannorrhaphis spinulosa*, n. sp. (Pl. 101, figs. 3, 4).

Tangential tubes cylindrical, straight, gradually tapering towards the two pointed ends, densely studded with conical spines, arising perpendicularly. (The specimen figured, fig. 3, exhibited two ovate central capsules, each of which contained two large nuclei, with numerous nucleoli.)

*Dimensions.*—Length of the tubular spicula 0·3 to 0·5, breadth 0·01 to 0·015.

*Habitat.*—North Pacific, Station 244, surface.

2. *Cannorrhaphis lampoxanthium*, n. sp.

Tangential tubes cylindrical, more or less curved, suddenly tapering towards the two pointed ends, densely studded with irregular conical spines of unequal length, which arise obliquely from their surface.

*Dimensions.*—Length of the tubular spicula 0·4 to 0·5, breadth 0·005 to 0·008.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

3. *Cannorrhaphis lappacea*, n. sp.

Tangential tubes spindle-shaped, gradually tapering towards the two pointed ends, densely studded with irregular lateral branches, which are partly simple, partly forked, more or less curved, and arise obliquely from their surface.

*Dimensions.*—Length of the tubular spicula 0·2 to 0·3, breadth 0·015 to 0·025.

*Habitat.*—Central Pacific, Station 271, surface.

4. *Cannorrhaphis spathillata*, n. sp. (Pl. 101, fig. 5).

Tangential tubes cylindrical, thin and straight, regularly zigzag, with pointed, regularly alternating lateral spines, with an elegant spathilla, or a cap-shaped verticil of eight to ten recurved spines on the two ends.

*Dimensions.*—Length of the tubular spicula 0·3, breadth 0·003.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

[1] *Cannorrhaphis*=Bearing hollow tubular needles ; κάννα, ῥαφίς.

## Subfamily 2. CATINULIDA, Haeckel.

*Definition.*—Cannorrhaphida with a skeleton composed of numerous cap-shaped pieces, which lie tangentially scattered on the surface of the spherical calymma. Each piece is a hemispherical or flatly cap-shaped siliceous body, often with radial striations, and with a thin solid wall.

### Genus 660. *Catinulus*,[1] n. gen.

*Definition.*—Cannorrhaphida with a skeleton composed of solid, cap-shaped or hemispherical, not fenestrated, pieces.

The genus *Catinulus* differs from all the other Cannorrhaphida in the peculiar shape of the numerous siliceous pieces, which are scattered on the surface of the calymma and compose their rudimentary skeleton. These pieces are neither hollow rings (as in the Dictyochida), nor hollow tubes (as in the Cannobelida), but solid hemispherical caps or more flatly vaulted small dishes. All the complete specimens of this genus which I observed exhibited four equal central capsules in the spherical calymma.

1. *Catinulus quadrifidus*, n. sp. (Pl. **117**, figs. 8, 8*a*).

Cap-shaped pieces of the skeleton flatly vaulted, three times as broad as high, smooth; the marginal ring with fine radial ribs and with smooth margin.

*Dimensions.*—Diameter of the calymma 0·6 to 0·8, of the four central capsules 0·12 to 0·2; breadth of the concave caps 0·024, height 0·008.

*Habitat.*—South Atlantic, Station 323, depth 1900 fathoms.

2. *Catinulus catillum*, n. sp.

Cap-shaped pieces of the skeleton flatly vaulted, three times as broad as high, rough, covered with numerous small spinules; the marginal ring with stout radial ribs and a corona of denticles on the margin.

*Dimensions.*—Breadth of the concave caps 0·03, height 0·01.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

3. *Catinulus lopadium*, n. sp.

Cap-shaped pieces of the skeleton hemispherical, twice as broad as high, smooth; the marginal ring smooth, slightly radiate, with thickened smooth margin.

*Dimensions.*—Diameter of the calymma 1·2, of the central capsule 0·22; breadth of the concave caps 0·024, height 0·012.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

[1] *Catinulus* = Small cup or dish.

### Subfamily 3. Dictyochida, Haeckel.

*Definition.*—Cannorrhaphida with a skeleton composed of numerous annular pieces, which lie tangentially scattered on the surface of the calymma. Each piece is either a simple hollow ring or a pileate and reticulate cap, composed of a ring and several connected bars.

### Genus 661. *Mesocena*,[1] Ehrenberg, 1841, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 401.

*Definition.*—Cannorrhaphida with a skeleton composed of simple annular pieces, each of which is a circular, elliptical or polygonal, not fenestrated, ring, with or without radial spines.

The genus *Mesocena* is the simplest form of the Dictyochida, and no doubt the common ancestral form of this subfamily. The siliceous pieces, which are scattered in variable and indefinite number in the calymma, are simple hollow rings, with or without spines on the periphery. Ehrenberg, who first described and figured such rings (found fossil in different Tertiary rocks) has mistaken them for Diatoms. Some species, which I found in the Challenger preparations, leave no doubt that these rings are the siliceous pieces of the skeleton of the simplest Dictyochida. They are scattered in great numbers in the spherical calymma, which surrounds a tripylean central capsule with all the characters of the Phæodaria. In the living body the rings probably always lie in the spherical periphery of the extracapsular jelly-veil, in tangential planes, whilst in some of the Challenger preparations the rings were scattered in hundreds throughout the whole jelly-mass. In a few species the rings are quite simple, circular or elliptical, smooth, and without teeth or spines. In the majority of species some teeth or radial spines, regularly disposed, arise from the periphery of each ring (two, three, four to eight; sometimes sixteen, eight smaller alternating with eight larger spines). In some species small teeth occur on the inner margin of the rings. The number of radial spines seems to be rather constant in all the rings of one and the same individual, with the exception of a few variations. Thus in *Mesocena octogona* I found here and there single rings with seven or nine teeth, instead of the usual number eight. Ehrenberg enumerated sixteen different species of *Mesocena;* many, however, of these are synonymous, being founded on slight variations in the number of the teeth; of others he has given only the name, but neither a figure nor a description (*e.g.*, *Mesocena stephanolithis*, *Mesocena spongolithis*, &c.).

[1] *Mesocena* = Hollow in the centre, annular; μέσον, κενός.

1. *Mesocena circulus*, Ehrenberg.

*Mesocena circulus*, Ehrenberg, 1840, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 208.
*Mesocena circulus*, Ehrenberg, 1854, Mikrogeol., Taf. xix. fig. 44.

Rings of the skeleton circular, smooth or slightly denticulate on the outer margin, without spines. This simple form is probably the ancestral form of the Dictyochida.

*Dimensions.*—Diameter of the rings 0·02 to 0·03, thickness of the hollow rod 0·001 or less.

*Habitat.*—Fossil in Tertiary rocks of Barbados and of the Mediterranean (Ægina, Greece; Caltanisetta, Sicily).

2. *Mesocena annulus*, n. sp.

? *Mesocena crenulata*, Ehrenberg, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 822.

Rings of the skeleton elliptical, smooth or slightly denticulate on the outer margin, without spines. This species is possibly identical with *Mesocena crenulata* of Ehrenberg, of which, however, no figure is given. The major axis of the ellipse is one and a half times as long as the minor.

*Dimensions.*—Diameter of the rings in the major axis 0·03, in the minor 0·02; thickness of the bars 0·002.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

3. *Mesocena diodon*, Ehrenberg.

*Mesocena diodon*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 84.
*Mesocena diodon*, Ebrenberg, 1854, Mikrogeol., Taf. xxxiii., Nr. xv. fig. 18.

Rings of the skeleton elliptical, smooth, with two opposite spines on the poles of the major axis, which is about one and one-third as long as the minor axis.

*Dimensions.*—Diameter of the rings in the major axis 0·04, in the minor 0·03; length of the spines 0·01.

*Habitat.*—Fossil in Barbados, and in North America (Virginia).

4. *Mesocena triangula*, Ehrenberg.

*Mesocena triangula*, Ehrenberg, 1840, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 208.
*Mesocena triangula*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 41.
*Dictyocha triangula*, Ehrenberg, 1875, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 46.
*Lithocircus triangularis*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 121, Taf. vii. fig. 10.

Rings triangular, with small peripheral thorns, and three larger teeth on the corners of the equilateral triangle.

*Dimensions.*—Diameter of the rings 0·03 to 0·05, length of the spines 0·01.

*Habitat.*—Fossil in Tertiary deposits of the Mediterranean; Caltanisetta, Sicily (Ehrenberg, Stöhr).

### 5. *Mesocena quadrangula*, Ehrenberg.

? *Mesocena quadrangula*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, pp. 145, 273.
? *Mesocena quaternaria*, Ehrenberg, 1855, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 302.

Rings square, with four radial spines on the corners of the square. Ehrenberg has given only the name of this species, but neither diagnosis nor figure. I think it may be identical with the species described, which I found in the North Atlantic.

*Dimensions.*—Diameter of the rings 0·02 to 0·025, length of the spines 0·007 to 0·01.

*Habitat.*—North Atlantic, Færöe Channel, Gulf Stream (John Murray), depth 600 fathoms.

### 6. *Mesocena elliptica*, Ehrenberg.

*Mesocena elliptica*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 84.
*Mesocena elliptica*, Ehrenberg, 1854, Mikrogeol., vol. i. Taf. xx. fig. 44.
*Dictyocha elliptica*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 44.

Rings elliptical or ovate, with four peripheral spines which lie in two diameters, perpendicular to one another, two opposite in the major, the two others in the minor axis of the ellipse.

*Dimensions.*—Diameter of the rings 0·015 to 0·03, length of the spines 0·005.

*Habitat.*—Fossil in Tertiary rocks of the Mediterranean (Placca di furni, from Zante, Greece); Caltanisetta, Sicily.

### 7. *Mesocena pentagona*, n. sp.

Rings regularly pentagonal, with smooth straight bars, and with five short and straight radial spines on the five corners.

*Dimensions.*—Diameter of the rings 0·02, length of the spines 0·005.

*Habitat.*—Fossil in Barbados.

### 8. *Mesocena hexagona*, Haeckel.

? *Mesocena senaria*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, pp. 163, 273.
? *Mesocena septenaria*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, pp. 163, 273.

Rings regular, hexagonal, with six radial spines on the six corners (sometimes between the usual six-radiate rings of one and the same individual are intermingled single rings with five or seven spines).

*Dimensions.*—Diameter of the rings 0·025 to 0·03, length of the spines 0·007 to 0·01.

*Habitat.*—Mediterranean, Krim (Ehrenberg), Corfu (Haeckel).

9. *Mesocena octogona*, Ehrenberg.

*Mesocena octogona*, Ehrenberg, 1841, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 417, Taf. i., Nr. iii. fig. 27.

? *Mesocena heptagona*, Ehrenberg, 1841, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 417, Taf. i., Nr. iii. fig. 26.

? *Mesocena heptagona*, Ehrenberg, 1854, Mikrogeol., Taf. xx. fig. 49.

? *Mesocena octoradiata*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, pp. 163, 273.

? *Mesocena nonaria*, Ehrenberg, 1872, Abhandl. d. k. Akad. d. Wiss. Berlin, pp. 163, 273.

Rings regular, octogonal, with eight radial spines on the eight corners of the ring (sometimes between the common octoradiate rings single rings with seven or nine teeth are intermingled in one and the same calymma).

*Dimensions.*—Diameter of the rings 0·02, length of the spines 0·005.

*Habitat.*—Tropical Pacific; Peru, Ehrenberg; Station 272 to 274, surface.

10. *Mesocena bisoctona*, Ehrenberg.

*Mesocena bisoctona*, Ehrenberg, 1845, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 78; Mikrogeol., Taf. xxxv., Nr. xviii. figs. 9, 10.

*Mesocena binonaria*, Ehrenberg, 1845, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 78, *loc. cit.*

Rings circular, with sixteen teeth; eight stronger teeth regularly disposed on the outer margin, alternating with these eight smaller teeth on the inner margin.

*Dimensions.*—Diameter of the rings 0·02, length of the outer spines 0·005.

*Habitat.*—Fossil in Guano from Peru and South Africa, also in Barbados.

11. *Mesocena stellata*, n. sp. (Pl. 101, fig. 9).

Rings circular, with sixteen teeth regularly disposed on the outer margin of the rings, eight stronger teeth alternating with eight smaller.

*Dimensions.*—Diameter of the rings 0·03, length of the larger spines 0·01.

*Habitat.*—Central area of the Pacific, Station 270, depth 2925 fathoms.

## Genus 662. *Dictyocha*,[1] Ehrenberg, 1838, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 128.

*Definition.*—Cannorrhaphida with a skeleton composed of annular pieces, which are fenestrated by one or more arches, arising on one side of the simple ring, but do not form a truncated pyramid (therefore no apical ring).

The genus *Dictyocha* is a very remarkable and interesting form of PHÆODARIA, which has had a curious history. Ehrenberg, who first observed single pieces of it fossil in Tertiary rocks, supposed it to be the siliceous carapace of a Diatom, and gave it the following

[1] *Dictyocha*=Net-possessing; δίκτυον, ἔχω.

diagnosis: "Dictyocha, e familia Bacillariorum. Lorica simplex univalvis silicea, laxe reticulata aut stellulata" (*loc. cit.*). In my Monograph (1862, p. 271), I placed it in the class Radiolaria, supposing that it might be a simple form of Acanthodesmida, having found only isolated siliceous pieces. Afterwards (in 1879) Richard Hertwig observed the entire living body, and demonstrated that the hollow siliceous pieces are scattered in great numbers around a tripylean central capsule, which exhibits all the essential characters of PHÆODARIA (Organismus d. Radiol., 1879, p. 89). Hertwig describes the position of the numerous siliceous pieces in the surface of the extracapsular jelly-sphere so densely aggregated, that they touch one another and produce the appearance of a reticulated sphere. In two specimens, which I observed living (Pl. 101, fig. 10), and in numerous complete specimens which I found in the collection of the Challenger, the number of the siliceous pieces was much smaller, and they were scattered irregularly in the surface of the alveolate jelly-sphere, being separated by wide and unequal intervals. The regular position seems to be that the basal rings lie tangentially in the spherical surface of the calymma, whilst the bars of the reticulum are directed outwards, and the apical spine radially in centrifugal direction. Very often two pieces are united by their basal rings in such a manner that they form a little spheroidal fenestrated body (as in *Distephanus*, Stöhr; compare p. 1550). The characteristic reticular skeleton-pieces of *Dictyocha* must be derived from *Mesocena;* from its simple siliceous ring (on one side of its plane), arise two, three, or four (rarely more) bars, which become united to a loose framework (with two, three, or four meshes). When this network assumes the form of a truncated pyramid (with a central mesh on the apex), *Dictyocha* passes over into *Distephanus*. From the corners of the original basal ring several radial spines usually arise in a centrifugal direction, and on the sides of these sometimes small teeth or thorns also run in a centripetal direction. The number of the meshes and the separating rods is usually four, more rarely two or three. The hollow rods are very thin, either cylindrical or prismatic. As the ascending rods alternate regularly with the corner-spines of the basal ring, we may call the latter perradial, the former interradial. Ehrenberg has distinguished in his genus *Dictyocha* not less than fifty species, thirty-five living and twenty-five fossil (ten species both living and fossil). The greater part of these cannot be retained, as they are only slight varieties or abnormalities of single pieces of the skeleton, such as very frequently occur associated with the common regular forms in one and the same individual. Such abnormal species are, *e.g.*, *Dictyocha abnormis*, *Dictyocha binoculus*, *Dictyocha bipartita*, *Dictyocha haliomma*, *Dictyocha hexathyra*, *Dictyocha septenaria*, &c. One species (*Dictyocha splendens*), is the fenestrated calcareous body of a Holothurian. Of some other species Ehrenberg has only given the name, but neither a description nor a figure (*e.g.*, *Dictyocha borealis*, *Dictyocha cenostephania*, *Dictyocha compos*, *Dictyocha coronata*, *Dictyocha socialis*, *Dictyocha specillum*). A number of other species must be placed in the genera *Distephanus* and *Cannopilus*, so that only eight of his species of true *Dictyocha* remain.

1. *Dictyocha navicula*, Ehrenberg.

*Dictyocha navicula*, Ehrenberg, 1838, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 129; Mikrogeol., Taf. xx., Nr. i. fig. 43.
*Dictyocha ponticulus*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 267.

Each individual ring elliptical or oblong, with one transverse arch in the shorter axis, which bisects it into two meshes. No spines or teeth.

*Dimensions.*—Diameter of the ring 0·02, of the bars 0·001.

*Habitat.*—Fossil in Tertiary deposits, Barbados, Sicily, &c.; living in the Atlantic, Stations 352, 354, and off Bermuda, surface.

2. *Dictyocha quadrata*, Ehrenberg.

*Dictyocha quadrata*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 267.

Each individual ring square or rhomboid, with one transverse arch in the shorter axis, forming two meshes. Two peripheral opposite spines on the poles of one axis.

*Dimensions.*—Diameter of the ring 0·015.

*Habitat.*—Atlantic, Bermuda Islands; fossil in Barbados.

3. *Dictyocha pons*, Ehrenberg.

*Dictyocha pons*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80; Mikrogeol., Taf. xxi. fig. 40.
*Dictyocha tripyla*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80; Mikrogeol., Taf. xxi. fig. 41.

Each individual ring elliptical or oblong, with one transverse arch in the shorter axis, forming two meshes. Four peripheral spines, on the poles of the longer and of the shorter axis. (The individual abnormality, figured as *Dictyocha tripyla, loc. cit.*, Taf. xxi. fig. 41, has the transverse arch bifid at one end, therefore three meshes result; this forms an interesting transition to *Dictyocha fibula*.)

*Dimensions.*—Diameter of the ring 0·01, of the bars 0·001.

*Habitat.*—Fossil in Tertiary rocks, Oran, Africa.

4. *Dictyocha triommata*, Ehrenberg.

*Dictyocha triommata*, Ehrenberg, 1845, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 76; Mikrogeol., Taf. xxxiii., Nr. xv. fig. 11.
*Dictyocha triactis* (= *triacantha*), Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80.
*Dictyocha trifenestrata*, Ehrenberg, 1841, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 410; Mikrogeol., Taf. xix. fig. 38.
*Dictyocha abyssorum*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 38.

Each pileated piece of the skeleton is a small three-sided pyramid, the sides of which form three triangular meshes; the three edges between them are three curved interradial beams, united in the

centre (the apex of the pyramid). Alternating with these, three horizontal, perradial, centrifugal spines start from the base.

*Dimensions.*—Diameter of the basal triangle 0·01, of the three meshes 0·005.

*Habitat.*—Fossil in different Tertiary deposits (of Sicily, Greece, North America); living in the Central Pacific, Stations 270 to 272, depth 2600 to 2925 fathoms.

### 5. *Dictyocha tripyla*, Ehrenberg.

*Dictyocha tripyla*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80.
*Dictyocha tripyla*, Ehrenberg, 1854, Mikrogeol., Taf. xix. fig. 38 (*et* Taf. xxi. fig. 41?).

Each pileate piece of the skeleton is a small three-sided pyramid, similar to that of *Dictyocha triommata*, but differs from it in the possession of three small perpendicular teeth, which are directed downwards and start from the basal ring near the origin of the three horizontal spines.

*Dimensions.*—Diameter of the triangular basal ring 0·015, of the three meshes 0·007.

*Habitat.*—Fossil in Tertiary deposits, North Africa (Oran), Sicily (Caltanisetta).

### 6. *Dictyocha medusa*, n. sp. (Pl. 101, figs. 13, 14).

Each pileated piece of the skeleton has four equal, cruciate, triangular meshes. From the four corners of the square basal ring proceed four perradial horizontal spines, and between these four interradial curved bars, which correspond to the edges of a four-sided pyramid, arise from the centre of the four sides and become united in the centre (on the apex of the pyramid). No apical spine.

*Dimensions.*—Diameter of the basal ring 0·02, of the four meshes 0·01.

*Habitat.*—Central area of the Pacific, Station 272, depth 2600 fathoms.

### 7. *Dictyocha staurodon*, Ehrenberg.

*Dictyocha staurodon*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80.
*Dictyocha staurodon*, Ehrenberg, 1854, Mikrogeol., Taf. xviii. fig. 58.

Each pileated piece of the skeleton is a small, regular, four-sided pyramid, similar to the foregoing species. It differs from *Dictyocha medusa* in the development of a vertical apical spine, and of four small centripetal teeth, which start from the inside of the basal square, between the four perradial spines and the four ascending interradial beams.

*Dimensions.*—Diameter of the basal ring 0·025, of the meshes 0·01.

*Habitat.*—Fossil in Tertiary rocks; Tripel of Richmond, Virginia (Ehrenberg); Barbados, (Haeckel); living in the Tropical Atlantic, Station 347, surface.

8. *Dictyocha fibula*, Ehrenberg.

*Dictyocha fibula*, Ehrenberg, 1839, Abhandl. d. k. Akad. d. Wiss. Berlin, p. 149; Mikrogeol., Taf. xviii. fig. 54, *a*, *b*, *c*, Taf. xix. fig. 43, Taf. xx. fig. 45, Taf. xxi. fig. 42, &c.
*Dictyocha abnormis*, Ehrenberg, 1845, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 76; Mikrogeol., 1854, Taf. xxxvA., Nr. xvii. fig. 9.
*Dictyocha bipartita*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 44.
*Dictyocha tenella*, Ehrenberg, 1841, Abhandl. d. k. Akad. d. Wiss. Berlin, Taf. ii. fig. 11.

Each pileated piece of the skeleton stirrup-shaped, with two pairs of meshes, and a square basal ring, the four corners of which are prolonged into four perradial spines. Between the latter four interradial beams arise from the sides in pairs, and the two pairs are connected by a diagonal arch. Therefore the two opposite meshes are larger and pentagonal, the other two meshes (alternating with these) are smaller and square. No vertical spine on the apex.

*Dimensions.*—Diameter of the basal square ring (diagonal) 0·01 to 0·02, of the meshes 0·005.

*Habitat.*—Fossil in different Tertiary rocks (Barbados, Oran, Greece, Sicily, &c.), Ehrenberg.

9. *Dictyocha messanensis*, Haeckel.

*Dictyocha messanensis*, Haeckel, 1862, Monogr. d. Radiol., p. 272, Taf. xii. figs. 3–6.
*Dictyocha fibula*, R. Hertwig (not Ehrenberg), 1879, Organismus d. Radiol., p. 89, Taf. ix. fig. 5.

Each pileated piece of the skeleton stirrup-shaped, very similar to *Dictyocha fibula*, but distinguished by a vertical apical spine in the centre of the transverse arch, which connects the two pairs of ascending bars.

*Dimensions.*—Diameter of the basal ring 0·02 to 0·03, of the meshes 0·01 to 0·016.

*Habitat.*—Mediterranean (Messina), North Atlantic (Canary Islands), Station 354, surface.

10. *Dictyocha epiodon*, Ehrenberg.

*Dictyocha epiodon*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 79; Mikrogeol., Taf. xviii. fig. 55.

Each pileated piece of the skeleton stirrup-shaped, with four paired meshes similar to the hats of *Dictyocha fibula*, but distinguished by four small centripetal thorns, which start from the inside of the basal ring, at the side of the four ascending beams. No apical spine.

*Dimensions.*—Diameter of the basal ring 0·03, of the meshes 0·01.

*Habitat.*—Fossil in Tertiary rocks of North America (Miocene Tripel of Richmond, Virginia, &c.).

11. *Dictyocha stapedia*, n. sp. (Pl. 101, figs. 10–12).

Each pileated piece of the skeleton stirrup-shaped, with four paired meshes, similar to the hats of *Dictyocha fibula* and *Dictyocha messanensis*, but distinguished by four small centripetal teeth, which start from the inside of the basal ring, at the side of the four ascending beams. In the centre of the diagonal arch arises a vertical apical spine (differing from *Dictyocha epiodon*). This species seems

to be the most common of the living forms and widely distributed over all warmer seas. I observed in Ceylon, taken on the surface, the living specimen figured in Pl. **101**, fig. 10; the numerous spicula were irregularly scattered over the spherical surface of the alveolate calymma. Other specimens occur in various preparations of the Challenger collection, from the Atlantic and the Pacific. The majority of the siliceous little hats exhibited the stirrup-form shown in fig. 11, and many were united in pairs, forming a twin-piece (fig. 12). Intermingled with these are found some irregular forms, representing the specific form of some allied species, viz., *Dictyocha speculum*, *Dictyocha staurodon*, *Dictyocha epiodon* and *Dictyocha messanensis*.

*Dimensions.*—Diameter of the basal ring 0·015 to 0·03, of the meshes 0·005 to 0·012.

*Habitat.*—Cosmopolitan; Atlantic, Pacific, Indian Ocean, in the Tropical and warmer regions; Stations 159, 244, 266–272, 318, 352, &c.

### 12. *Dictyocha rhombus*, n. sp.

Each pileated piece of the skeleton stirrup-shaped, similar to *Dictyocha stapedia*, with four paired meshes. It differs from the latter in the rhomboid form of the basal ring and the larger size of the two opposite meshes, which are two to three times as large as the two others. Therefore the four centripetal teeth of the basal ring do not stand in the four single meshes, but in pairs only in the two larger meshes.

*Dimensions.*—Diameter of the basal ring 0·02, of the meshes 0·005 to 0·01.

*Habitat.*—North Atlantic; Færöe Channel, Gulf Stream, depth 50 to 600 fathoms, John Murray.

## Genus 663. *Distephanus*,[1] Stöhr, 1880, Palæontogr., vol. xxvi. Taf. ii. p. 121.

*Definition.*—Cannorrhaphida with a skeleton composed of pileated pieces, each of which is a small truncated pyramid with one girdle of meshes (the apical ring being simple).

The genus *Distephanus* was founded in 1880 by Stöhr (*loc. cit.*) for a single twin-piece of the skeleton of *Dictyocha speculum*. Among the common fossil forms of this species he once found in the Tertiary rocks of Caltanisetta, Sicily, a single piece (*loc. cit.*, Taf. vi. fig. 9), which seemed to be composed of two equal pieces so united that they formed a little sphere with fourteen meshes; on each pole of the sphere lies a central hexagonal mesh surrounded by six pentagonal meshes, and from the six corners of the equatorial ring arise six centrifugal spines. No doubt this was a mistake, and the apparent little sphere was one of the above mentioned twin-forms, composed of two separate hexagonal truncated pyramids, which were loosely connected by their basal rings. I have often seen such twin-pieces of *Dictyocha speculum* and of other species (Pl. **101**, fig. 12; Pl. **114**, fig. 8), and was always able to separate the two loosely connected halves of the bivalve shell by slight compression.

[1] *Distephanus* = Double corona; διστέφανος.

The genus *Distephanus* of Stöhr, therefore, is nothing other than the *Dictyocha* of Ehrenberg. But I think it is more convenient to retain the name *Distephanus* for those forms of *Dictyocha* which possess a simple apical mesh surrounded by a ring of lateral meshes, and in which each piece of the skeleton forms a small truncated pyramid. The basal plane of this pyramid is marked by the original basal ring (*Mesocena*), the truncated upper plane by the parallel apical ring, and the edges of the pyramid by the rising bars which connect both rings. In this sense, so far as the two rings lying in parallel planes are concerned, the term *Distephanus* is correct (but not in the original sense of Stöhr). The number of the rising bars between the two rings varies from four, five, six to eight or more. It seems rather constant in each species, so that all the pieces of the skeleton of one specimen possess either four or six or eight lateral meshes, &c. But sometimes individual irregularities occur. In the majority of species each skeleton-piece is armed with spines. Usually a radial horizontal spine starts centrifugally from each corner of the basal ring, and on the side of this a small tooth or thorn often starts centripetally or downwards. In the twin-pieces, where the two basal rings are united, these teeth catch into one another. In some species upper spines also occur, starting from the corners of the apical ring. The perradial spines of the corners of the basal ring alternate regularly with the interradial ascending bars, which bisect the sides of the ring, as in *Dictyocha*.

1. *Distephanus crux*, Haeckel.

*Dictyocha crux*, Ehrenberg, 1840, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 207; Mikrogeol., 1854, Taf. xviii. fig. 56, Taf. xx. fig. 46, Taf. xxxiii. Nr. xv. fig. 9.
*Dictyocha bipartita*, Ehrenberg, 1844, *loc. cit.*, p. 79, Taf. xxii. fig. 44.

Each pileated piece of the skeleton exhibits four pentagonal lateral meshes around one square central mesh, and is composed of two horizontal square rings; the smaller upper square is connected with the larger lower square by four ascending interradial beams, which start from the corners of the former and bisect the sides of the latter; from the corners of the basal ring arise four short perradial spines.

*Dimensions.*—Diameter of the basal ring 0·02 to 0·03, of the apical ring 0·008.

*Habitat.*—Tropical Atlantic, Station 347, surface; fossil in Tertiary deposits of the Mediterranean (Sicily, Oran).

2. *Distephanus mesophthalmus*, Haeckel.

*Dictyocha mesophthalma*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80; Mikrogeol., 1854, Taf. xxii. fig. 43.

Each pileated piece of the skeleton exhibits four lateral meshes around the central mesh, and is composed of two parallel horizontal square rings, like those of *Distephanus crux*, but distinguished

from this by eight short teeth, four centripetal on the larger lower ring and four perradial centrifugal on the smaller upper ring.

*Dimensions.*—Diameter of the basal ring 0·03, of the apical ring 0·015.

*Habitat.*—Fossil in Tertiary rocks of Sicily, Caltanisetta (Ehrenberg); living in the Central Pacific, Station 270 to 272, surface.

### 3. *Distephanus stauracanthus*, Haeckel.

*Dictyocha stauracanthus*, Ehrenberg, 1845, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 76; Mikrogeol., 1854, Taf. xxxiii., Nr. xv. fig. 10.

Each pileated piece of the skeleton exhibits four lateral meshes around the central mesh, and is composed of two horizontal rings, which are connected by four perradial beams arising from the corners of the upper and smaller square ring. Lower ring octagonal, with eight peripheral adradial spines, and with four interradial centripetal teeth on the inside.

*Dimensions.*—Diameter of the basal ring 0·02, of the apical ring 0·004.

*Habitat.*—Fossil in Tertiary rocks of North America (Hollis Cliff, Virginia; Norwich, Connecticut).

### 4. *Distephanus asteroides*, n. sp.

*Dictyocha asteroides*, Haeckel, 1881, Prodromus.

Each pileated piece of the skeleton exhibits five lateral meshes around the central mesh (or the upper ring). Five peripheral spines (on the corners of the lower ring) simple, not articulated.

*Dimensions.*—Diameter of the basal ring 0·02, of the apical ring, 0·007.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

### 5. *Distephanus pentasterias*, Haeckel.

*Dictyocha pentasterias*, Ehrenberg, 1839, Mikrogeol., Taf. xviii. fig. 61.
? *Dictyocha quinaria*, Ehrenberg, 1842, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 265.
? *Dictyocha elegans*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80; Mikrogeol., 1854, Taf. xxii. fig. 51.
*Actiniscus elegans*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 51.

Each pileated piece of the skeleton exhibits five lateral meshes around the central mesh (or the upper ring). Five peripheral spines (on the corners of the lower ring) articulated, triangular, with three distinct joints (tapering towards the distal end).

*Dimensions.*—Diameter of the basal ring 0·012 to 0·018, of the apical ring 0·002 to 0·003.

*Habitat.*—Cosmopolitan; living in the depths of the Atlantic and Central Pacific, Stations 247, 270 to 272, depths 2530 and 2600 to 2925 fathoms; fossil in Tertiary deposits (Tripel of Caltanisetta, Sicily; Richmond, Virginia).

6. *Distephanus speculum*, Haeckel.

*Dictyocha speculum*, Ehrenberg, 1837, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 150; Mikrogeol., 1854, Taf. xviii. fig. 57, Taf. xix. fig. 41, Taf. xxi. fig. 44, Taf. xxii. fig. 47, &c.
*Dictyocha speculum*, Stöhr, 1880, Palæontogr., vol. xxvi., Taf. vii. fig. 8.
*Dictyocha anacantha*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 238.
*Dictyocha diommata*, Ehrenberg, 1854, Mikrogeol., Taf. xxxiii., Nr. xvii. fig. 6.
*Dictyocha erebi*, Ehrenberg, 1854, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 238.
*Dictyocha haliomma*, Ehrenberg, 1844, Mikrogeol., 1854, Taf. xxi. fig. 46.
*Dictyocha hexathyra*, Ehrenberg, 1844, Mikrogeol., 1854, Taf. xxii. fig. 46.
*Dictyocha ubera*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80.
*Dictyocha stella*, Ehrenberg, 1854, Mikrogeol., Taf. xxii. fig. 52.
*Distephanus rotundus*, Stöhr, 1880, Palæontogr., vol. xxvi., Taf. vii. fig. 9.

Each pileated piece of the skeleton is a truncated, six-sided pyramid, and composed of two regular hexagonal rings which lie in parallel plains, and are connected by six ascending interradial beams; these start from the corners of the upper smaller ring and bisect the sides of the lower larger ring; from the corners of the latter start six perradial centrifugal spines.

*Dimensions.*—Diameter of the basal ring 0·03, of the apical ring 0·01.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific; fossil in Barbados, Sicily, &c.

7. *Distephanus ornamentum*, Haeckel.

*Dictyocha ornamentum*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80; Mikrogeol., 1854, Taf. xxii. fig. 49.
*Dictyocha binoculus*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 79; Mikrogeol., 1854, Taf. xix. fig. 42.

Each pileated piece of the skeleton is a truncated, six-sided pyramid, similar to that of *Distephanus speculum*, but distinguished by six small (probably vertical) teeth, which start from the inside of the lower (larger) ring, on the sides of the ascending beams.

*Dimensions.*—Diameter of the basal ring 0·03, of the apical ring 0·015.

*Habitat.*—Fossil in Tertiary deposits of Sicily, Caltanisetta (Ehrenberg).

8. *Distephanus aculeatus*, Haeckel.

*Dictyocha aculeata*, Ehrenberg, 1839, Abhandl. d. k. preuss. Akad. d. Wiss. Berlin, p. 149; Mikrogeol., 1854, Taf. xxii. fig. 48, Taf. xix. fig. 40.
*Dictyocha aculeata*, Stöhr, 1880, Palæontogr., vol. xxvi. p. 120, Taf. vii. fig. 7.
*Dictyocha bisternaria*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 201.

Each pileated piece of the skeleton is a truncated, six-sided pyramid, similar to that of *Distephanus speculum*, but distinguished by six small perradial, horizontal teeth, which start from the sides of the upper (smaller) ring.

*Dimensions.*—Diameter of the basal ring 0·02, of the apical ring 0·008.

*Habitat.*—Fossil in Tertiary deposits of the Mediterranean; plastic clay of Greece and Sicily; living in the Mediterranean and the Atlantic, Station 352, surface.

9. *Distephanus sirius*, Haeckel.

*Actiniscus sirius*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 68.
*Dictyocha sirius*, Ehrenberg, 1854, Mikrogeol., Taf. xviii. fig. 59.

Each pileated piece of the skeleton is a truncated six-sided pyramid, similar to that of *Distephanus speculum*, but distinguished by the six broad, triangular, peripheral spines, which are articulated and connected by a thin siliceous membrane (like a web-membrane); each spine has three articulations (as in *Dictyocha pentasterias*).

*Dimensions.*—Diameter of the basal ring 0·02, of the apical ring 0·005.

*Habitat.*—Fossil in Tertiary rocks (Richmond, Virginia), but also living in the Atlantic Ocean, Gulf Stream, Færöe Channel, John Murray, 1880.

10. *Distephanus corona*, n. sp. (Pl. 114, figs. 7–9).

*Dictyocha corona*, Haeckel, 1881, Prodromus.

Each pileated piece of the skeleton is a truncate six-sided pyramid, like that of *Distephanus speculum*, but differing in the number (twenty-four) of teeth or spines. Six interradial ascending beams connect the two horizontal rings between these, and six nearly vertical spines arise from the perradial corners of the upper hexagonal ring. In the same meridional (perradial) plains six larger spines descend downwards from the corners of the lower larger ring. Between these six descending spines and the six ascending beams arise from the upper edge of the lower ring twelve shorter teeth of unequal size (the right tooth in each pentagonal lateral mesh being smaller, and directed upwards, the left tooth being larger and directed nearly horizontally outwards). The lower ring is nearly dodecagonal.

*Dimensions.*—Diameter of the basal ring 0·025 to 0·03, of the apical ring 0·012 to 0·02.

*Habitat.*—North-west Pacific, Sea of Japan, Station 231, depth 2250 fathoms.

11. *Distephanus octonarius*, Haeckel.

*Dictyocha octonaria*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 201.
*Dictyocha polyactis*, Ehrenberg, 1844, *loc. cit.*, p. 80; Mikrogeol., 1854, Taf. xxii. fig. 50.
*Dictyocha septenaria*, Ehrenberg, 1844, *loc. cit.*, p. 80; Mikrogeol., 1854, Taf. xxi. fig. 45.

Each pileate piece of the skeleton is a truncated eight-sided pyramid, composed of two regular octagonal rings, which lie in parallel plains and are connected by eight radial beams. From the eight outer corners of the lower ring (or from the eight interradial meshes, between the eight perradial beams) start eight basal centrifugal spines. (This species is similar to *Distephanus speculum*, but has eight beams instead of six. In single pieces the number of the beams and meshes varies between seven and nine, the constant number being eight.) A seven-rayed variety is *Dictyocha septenaria* (*loc. cit.*), a nine-rayed *Dictyocha polyactis*.

*Dimensions.*—Diameter of the basal ring 0·02 to 0·03, of the apical ring 0·01 to 0·015.

*Habitat.*—Fossil in Tertiary rocks (Tripel and Marne from Caltanisetta, Sicily; Oran, Africa); living in the depths of the Atlantic, Station 348, and Pacific, Station 270, &c.

12. *Distephanus octogonius*, n. sp.

*Dictyocha septenaria*, Ehrenberg, 1854, Mikrogeol., Taf. xxxvA., Nr. xxi. fig. 8.

Each pileated piece of the skeleton is a truncated eight-sided pyramid, like that of *Distephanus octonarius*, but differs from it by having eight short erect teeth, which arise from the corners of the upper smaller ring and lie in the same perradial plains as the eight horizontal spines starting from the corners of the lower larger ring. (Ehrenberg has figured only an individual abnormality with seven beams instead of eight, taken from the Antarctic ice; but I found the same form frequent in deep-sea soundings from the Antarctic, almost constantly with eight beams, isolated hats with six, seven, or nine beams being intermingled.

*Dimensions.*—Diameter of the basal ring 0·02, of the apical ring 0·012.

*Habitat.*—Antarctic Ocean; in smolten "Pancake-Ice," taken by Sir James Clark Ross in lat. 78° 10′ S., long. 162° W. (Ehrenberg); Station 156, depth 1975 fathoms.

13. *Distephanus diadema*, n. sp.

*Dictyocha diadema*, Haeckel, 1881, Prodromus.

Each pileated piece of the skeleton is an eight-sided pyramid, like that of the two foregoing species, but differing in the number and distribution of the teeth or spines, which are thirty-two. From the eight corners of the basal ring start eight long, nearly horizontal perradial spines, which bear on each side a smaller, nearly vertically descending spine. From the eight corners of the upper ring ascend also eight perradial spines, alternating with the eight interradial beams, which connect the two rings.

*Dimensions.*—Diameter of the basal ring 0·04, of the apical ring 0·02.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

## Genus 664. *Cannopilus*,[1] n. gen.

*Definition.*—Cannorrhaphida with a skeleton composed of pileated pieces, each of which is a small truncated pyramid with two girdles of meshes (the apical ring being fenestrated).

The genus *Cannopilus* represents the most highly developed form of Dictyochida. Each piece of the skeleton is a little fenestrated hat or topped pyramid, as in *Distephanus*. But the apical mesh is simple in the latter, in the former it is divided into several meshes by bars which start in a centripetal direction from the upper ring. Therefore we find two annular rows of meshes, one above the other; an apical or upper row of smaller meshes and a basal or lower row of larger meshes. In the apex of the little

[1] *Cannopilus* = Hat with tubes; κάννα, πῖλος.

hat is either a central mesh or an apical spine. Other spines arise from the basal ring, as in the former genera. The number of corner-spines on the basal ring is either four, six, or eight (in individual abnormalities also five or seven).

1. *Cannopilus superstructus*, Haeckel.

*Dictyocha superstructa*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 80; Mikrogeol., Taf. xxii. fig. 45.

Each pileated piece of the skeleton is a reticulated four-sided pyramid. The base of it (or the lower ring) is a square, from the four perradial corners of which start four centrifugal horizontal spines. In the centres of the four basal bars (or the sides of the square) arise four interradial beams, which unite in the second (or upper) square ring. This latter forms a second (but much smaller) four-sided pyramid, the apex of which is truncated. Therefore the little hat bears nine meshes; around the large central opening four upper smaller and four lower larger quadrangular meshes.

*Dimensions.*—Diameter of the basal ring 0·03, of the apical ring 0·01.

*Habitat.*—Fossil in Tertiary rocks of Sicily (Caltanisetta).

2. *Cannopilus diplostaurus*, n. sp. (Pl. 114, fig. 10).

Each pileated piece of the skeleton is a truncated quadrangular pyramid. From the corners of the square basal ring start four perradial, nearly horizontal, spines. Between these arise four interradial beams, which are united above by an upper square ring. This latter is divided into four small square meshes by a regular cross of perradial bars, the distal ends of which are prolonged into four short ascending spines. In the centre of the cross arises a vertical apical spine.

*Dimensions.*—Diameter of the basal ring 0·04, of the apical ring 0·016.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

3. *Cannopilus calyptra*, Haeckel.

*Dictyocha heptacanthus*, Ehrenberg, 1840, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 208; Mikrogeol., 1854, Taf. xix. fig. 39 (?).

Each pileated piece of the skeleton is a truncated six-sided pyramid, like that of *Dictyocha speculum*, but distinguished by the reticulation of the upper (smaller) ring, which is divided by six beams into six meshes, lying in the horizontal plane of the upper ring. Six peripheral spines on the corners of the lower ring. (The irregular form, figured by Ehrenberg as *Dictyocha heptacanthus*, *loc. cit.*, is probably only an individual abnormality with seven peripheral spines, instead of six; similar abnormalities occur also among the regular hexagonal forms which I found in the Tertiary rocks of Caltanisetta (Sicily).

*Dimensions.*—Diameter of the basal ring 0·05, of the apical ring 0·02.

*Habitat.*—Fossil in Tertiary deposits of Greece and Sicily.

4. *Cannopilus hemisphæricus* (Haeckel).

*Dictyocha hemisphærica*, Ehrenberg, 1844, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 266.

Each pileated piece of the skeleton is nearly hemispherical, with thirteen meshes; six lower and larger meshes in the sides of the truncated six-sided pyramid, seven others in the convex surface of the upper ring (one central with six surrounding it). From the six corners of the lower ring arise six horizontal perradial spines. From the inside of the same ring (probably on the side of the six ascending interradial beams) spring six centripetal teeth.

*Dimensions.*—Diameter of the basal ring 0·02, of the apical ring 0·01.

*Habitat.*—North Atlantic; Bermuda (Bailey).

5. *Cannopilus cyrtoides*, n. sp. (Pl. 114, figs. 11, 12).

*Dictyocha cyrtoides*, Haeckel, 1881, Prodromus.

Each pileated piece of the skeleton is an eight-sided truncated pyramid, or nearly hemispherical. From the basal ring arise twenty-four thorns or teeth, eight longer perradial centrifugal teeth placed almost horizontally, and between these sixteen shorter adradial teeth, directed downwards and somewhat centripetally. The network of the small hat is composed of seventeen meshes, arranged in two rows. The eight lower meshes are hexagonal, separated by six interradial ascending beams, and twice as large as the eight upper pentagonal meshes, which are separated by eight perradial beams, and enclose an apical central mesh.

*Dimensions.*—Diameter of the basal ring 0·04, of the apical ring 0·005.

*Habitat.*—Central area of the Pacific, Station 266, depth 2750 fathoms.

## Family LXXIII. AULACANTHIDA, Haeckel (Pls. 102–105).

*Aulacanthida*, Haeckel, 1862, Monogr. d. Radiol., p. 262.

*Definition.*—PHÆODARIA with an incomplete skeleton, composed of numerous hollow radial tubes, which pierce the spherical calymma and touch with their proximal ends the surface of the tripylean central capsule.

The family Aulacanthida represents a large and interesting group of PHÆODARIA, differing from all other families of this legion in the possession of numerous large radial tubes, which pierce the gelatinous and alveolated calymma in a radial direction, and come in contact with the outer surface of the central capsule by their inner or proximal ends, whilst their outer or distal ends project over the surface of the spherical calymma, and develop a great variety of manifold branches and terminal appendages. Usually (with the exception of a single genus only) the surface of the calymma is covered by an

arachnoidal veil or mantle, composed of thousands of very fine, hollow, tangential needles. The skeleton therefore is incomplete, without any direct connection between the isolated pieces, just as in the preceding Cannorrhaphida, but the latter never possess the large, hollow, cylindrical, radial tubes, which are characteristic of all Aulacanthida.

The spherical body of the Aulacanthida has usually a diameter of 1 to 2 mm., and including the radial tubes, of 4 to 5 mm. or more. Some species are very common and cosmopolitan, and some genera contain numerous species, distributed widely over all oceans. In spite of their considerable size and wide distribution, only one species of this great family has been hitherto known, having been discovered by me at Messina in 1859, and described in my Monograph as *Aulacantha scolymantha* (1862, p. 263, Taf. ii. figs. 1, 2, and Taf. iv. figs. 1–5). I there founded for it the peculiar subfamily Aulacanthida, and annexed it to the Thalassicollida. The same cosmopolitan species has been subsequently observed at Messina by R. Hertwig, who first recognised the three openings in its central capsule, and therefore united it with his TRIPYLEA (Organism. d. Radiol., 1879, p. 88, Taf. ix. figs. 3, 4; Taf. x. figs. 7, 10). The rich collection of the Challenger has added an astonishing number of new and interesting forms of Aulacanthida, so that I can describe here not less than six genera and fifty-eight species. The majority are inhabitants of the colder parts of the South Pacific and South Atlantic, at great depths, whilst a few species only are found in the tropics.

The structure of the body in all Aulacanthida seems to be similar in all important points, and the differences by which we are enabled to separate this great number of species are mainly produced by differences in the development of the radial tubes, their form and their polymorphous apophyses. The entire body represents a rather firm jelly-sphere of 1 to 2 mm. diameter (rarely less or more); the peripheral layer of the spherical calymma is rather clear and transparent, whilst its central part is dark and opaque, containing the big phæodium and the enclosed central capsule. The diameter of the latter is usually between 0·1 and 0·3, often 0·4 to 0·5, or even more. The gelatinous calymma, in the centre of which the capsule is placed, always contains numerous, large, spherical or roundish alveoles, similar to those of *Thalassicolla*, and between them a delicate network of sarcode (Pl. 102, fig. 1; Pl. 103, fig. 1; Pl. 104, fig. 1).

The spherical surface of the calymma is nearly always protected by that characteristic arachnoidal veil or mantle, which is composed of thousands of very fine tangential needles, densely interwoven in all tangential directions, but never directly connected. They are wanting in a single genus only, in *Aulactinium* (Pl. 101, figs. 6–8). This genus, therefore, may represent a separate subfamily, the Aulactinida, whilst all other genera protected by that mantle constitute the subfamily Aulographida. The tangential needles always seem to have the same shape as I have accurately described, in 1862, of *Aulacantha scolymantha*. They are constantly smooth, very thin and fragile, but also very elastic cylinders of silica, of equal breadth throughout their whole length, and seem

to be open at both ends, since they are easily and constantly filled by air when dried. Their length is usually between 0·2 and 0·3 mm., rarely less than 0·15 or more than 0·5; their diameter is always less than 0·001, usually less than 0·0005.

The large radial tubes of the Aulacanthida constitute the most characteristic structures of this family, and are always so placed that their inner or proximal ends are in loose contact with the outer surface of their central capsule (upon which they rest), whilst their outer or distal ends are more or less prominent over the spherical surface of the calymma. Their position, therefore, is rather loose and movable, since they are fixed only by the consistence of the jelly of the surrounding calymma, and on the surface of the latter by the covering veil or the mantle of tangential needles (compare Pl. **102**, fig. 1; Pl. **103**, fig. 1; Pl. **104**, fig. 1). Their number seems never to be fixed, and is probably very variable in different species. I found, in 1859, in the common *Aulacantha scolymantha*, the number varying from thirty to one hundred and fifty (*loc. cit.*, p. 264). So also in *Aulographis pandora*, *Aulospathis variabilis*, and some other common species, numerous specimens of which I could compare, I found their number very variable, being in one and the same species sometimes only from ten to twenty, at other times from fifty to eighty, and sometimes even from one hundred to one hundred and fifty or more. Perhaps the number increases with the age and the increasing size of the calymma.

The radial tubes are always cylindrical (circular in transverse section), never angular or prismatic. Usually they are straight, more rarely slightly curved (Pl. **105**, figs. 1, 2; Pl. **101**, fig. 6). The cylinders are usually more or less tapering towards both ends, sometimes even spindle-shaped; the inner or proximal end is always simple and rounded, often slightly swollen or inflated, and ovate; the outer or distal end is often thickened, club-shaped, and exhibits the greatest variety in form and ramification. The length of the radial tubes is usually from 1 to 3 mm., rarely less than 0·8, or more than 3·2; their diameter is usually between 0·02 and 0·03, rarely less than 0·01 or more than 0·05. The smallest radial tubes are found in *Aulactinium*, the largest in *Aulospathis*.

The siliceous wall of the cylindrical radial tubes is usually very thin, fragile, and perfectly structureless. Only in a few species, mainly of *Aulographis*, does the wall become very thick and composed of concentric cylindrical layers (Pl. **105**, figs. 6–11). Their cavity is wide and simple, and filled up by jelly (not by sarcode, as I supposed in my first description). The simple cavity of the tubes, though not smaller than in the radial tubes of the Aulosphærida, Circoporida and Tuscarorida, never contains the characteristic axial filament with its branches, which is constantly found in the latter families. According to the description of R. Hertwig, the tubes are perfectly closed and have no opening. I suppose, however, that a small opening always exists in the centre of the rounded base, and perhaps a second on the distal apex. Otherwise the circumstance that the entire and well-preserved tubes become easily and constantly filled

up by air, when purified by hot mineral acids and afterwards dried, cannot be explained. I suppose that the jelly contained in the cavity of the tubes remains in constant connection by those openings with the jelly of the surrounding calymma.

The distal ends of the radial tubes exhibit in the Aulacanthida the greatest variety in the production of different branches and capturing apparatus, and this serves for the distinction of the genera and subgenera here described. In two genera only (in *Aulactinium* Pl. 101, figs. 6–8; and in *Aulacantha*, Pl. 105, fig. 16), the distal ends are simple, not branched. In the four other genera they are armed with terminal branches, which are usually arranged in elegant verticils. The greatest variety in the formation of these verticils is developed in *Aulographis* (Pl. 103). The single branches of the terminal verticils are here simple, whilst in the closely allied *Auloceras* they are forked or elegantly ramified (Pl. 102). *Aulospathis*, the biggest of all Aulacanthida, is distinguished by the possession of a verticil of lateral branches, placed beyond the terminal verticil, immediately above the veil of tangential needles (Pl. 104). *Aulodendron*, finally, possesses lateral and terminal branches, which are irregularly scattered.

The branches of the radial tubes are rarely straight, usually more or less curved, either simple or again ramified. Their surface is either smooth or armed with small spines or recurved teeth, often elegantly dentated or serrated (Pl. 103, figs. 20–27; Pl. 105, figs. 7–13). Their distal ends are either simply pointed or armed with a spathilla, or a small crown of verticillate, usually recurved teeth (Pl. 104, figs. 4–17). The variety and elegance of these minute armatures are very interesting, the more so as they occur in very similar and analogous forms among the Aulosphærida, the Cœlographida, and other PHÆODARIA.

The *central capsule* of the Aulasphærida and its large nucleus ("Binnenbläschen"), as well as the surrounding alveolate calymma ("Alveolen-Hülle"), and the enclosed dark phæodium ("dunkles Pigment") were first described in my Monograph (1862, *loc. cit.*, p. 362). Their minute structure has been examined afterwards very accurately by R. Hertwig (1879, *loc. cit.*, p. 95). The numerous well-preserved preparations of the Challenger (stained with carmine and preserved in glycerine) which I could examine, confirmed in all respects the detailed description of Hertwig (compare Pl. 102, fig. 1; Pl. 103, fig. 1; Pl. 104, fig. 1).

The spherical or subspherical central capsule is usually slightly depressed in the shortened main axis. Its diameter is usually between 0·1 and 0·3, rarely less than 0·08 or more than 0·4 mm. Its outer membrane (*e*) is thick and double-contoured, separated by a clear interval from the very thin but firm inner membrane (*i*). The large astropyle, or the main-opening on the oral pole of the main axis, is closed by a large, convex, radiate operculum (*o*), from which arises a short tubular proboscis. On both sides of the opposite aboral pole (to the right and left) are two conical parapylæ or secondary openings (*u, u*). The space between the inner membrane of the capsule and

the nucleus is filled up by protoplasm, containing numerous spherical vacuoles of equal size (*v*); each vacuole encloses a small, dark, fat-granule. The large nucleus (*n*) is either spherical or lenticular, and more or less depressed in the main axis; its diameter is usually about half as great as that of the enclosing capsule, 0·05 to 0·15, rarely less or more; it contains, enclosed in a clear mass, numerous dark, roundish or oblongish nucleoli (*l*).

Numerous preparations of Aulacanthida exhibited a central capsule with two nuclei (Pl. 101, fig. 6), or a calymma with two central capsules (Pl. 104, figs. 1, 3); so that the process of propagation by self-division, observed already in many different PHÆODARIA, seems to happen very frequently in the Aulacanthida. The voluminous phæodium is usually about twice or three times as large as the central capsule, and covers its oral or anterior half; the colour of the roundish phæodella composing it is sometimes more green or brown, at other times more blackish. The roundish alveoles, which fill up the rather firm jelly of the calymma, exhibit nearly the same shape as in the common *Thallassicolla nucleata*. The surface of the calymma is usually protected by the dense veil of tangential needles, and often forms conical or tent-shaped elevations around the bases of the piercing radial tubes (Pl. 102, fig. 1).

*Synopsis of the Genera of Aulacanthida.*

| | | |
|---|---|---|
| Radial tubes simple, without lateral and terminal branches. | Surface of the calymma naked, without tangential needles, . . . . | 665. *Aulactinium.* |
| | Surface of the calymma covered by a veil of tangential needles, . . . . | 666. *Aulacantha.* |
| Radial tubes without lateral branches, but with a verticil of terminal branches. | Terminal branches simple, . . . | 667. *Aulographis.* |
| | Terminal branches forked or again ramified, . | 668. *Auloceros.* |
| Radial tubes with lateral and with terminal branches. | Lateral branches verticillate, . . . | 669. *Aulospathis.* |
| | Lateral branches irregularly scattered, not verticillate, . . . . | 670. *Aulodendron.* |

## Subfamily 1. AULACTINIDA, Haeckel.

*Definition.*—Aulacanthida without external veil of tangential needles on the surface of the calymma.

### Genus 665. *Aulactinium*,[1] n. gen.

*Definition.*—Aulacanthida without a veil of tangential needles, with simple radial tubes, which bear neither lateral nor terminal branches.

[1] *Aulactinium* = With radial tubes; *αὐλός, ἀκτίς.*

The genus *Aulactinium* differs from all the other Aulacanthida in the complete absence of the characteristic fine tangential needles, which constitute in the latter an arachnoidal veil or mantle around the spherical calymma. We accordingly divide the whole family into two subfamilies, the Aulactinida with a naked calymma, and the Aulagraphida with a veil of tangential needles. The radial tubes possess in the few species of *Aulactinium* observed a very simple shape, as in the closely allied *Aulacantha*.

1. *Aulactinium actinastrum*, n. sp. (Pl. 101, figs. 6, 7).

Radial tubes slenderly spindle-shaped, slightly curved, gradually tapering from the middle towards both ends. The proximal two-thirds of the tubes enclosed in the calymma are smooth; the distal freely prominent third is armed with six to eight equidistant verticils of small conical teeth (ten to fifteen in each verticil).

*Dimensions.*—Length of the tubes 0·5 to 1·5, breadth 0·02.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

2. *Aulactinium actinelium*, n. sp. (Pl. 101, fig. 8).

Radial tubes cylindrical, straight, slightly tapering towards both ends. Proximal two-thirds smooth, the distal third studded with numerous small recurved thorns.

*Dimensions.*—Length of the tubes 0·6 to 0·9, breadth 0·02.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

3. *Aulactinium actinosphærium*, n. sp.

Radial tubes cylindrical, straight, smooth, of nearly equal breadth throughout their whole length, without thorns and spathillæ, pointed at both ends.

*Dimensions.*—Length of the tubes 1·6 to 2·2, breadth 0·02 to 0·03.

*Habitat.*—Antarctic Sea, Station 157, depth 1950 fathoms.

## Subfamily 2. AULOGRAPHIDA, Haeckel.

*Definition.*—Aulacanthida with an external veil of interwoven, very numerous and thin, hollow, tangential needles, entirely covering the surface of the calymma.

### Genus 666. *Aulacantha*,[1] Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 799.

*Definition.*—Aulacanthida with a veil of tangential needles, and with simple radial tubes, which bear neither lateral nor terminal branches.

[1] *Aulacantha*=Tubular spine; *αὐλός, ἄκανθα.*

The genus *Aulacantha*, hitherto the only representative of this family, was founded by me in 1860 for the cosmopolitan *Aulacantha scolymantha*, the most common and most widely distributed of all the members of the family. It is the simplest form of the Aulographida, or of those Aulacanthida in which the spherical surface of the calymma is densely covered with interwoven tangential needles. The large radial tubes of *Aulacantha* possess a very simple shape, as in the preceding *Aulactinium*, and have neither lateral nor terminal branches.

1. *Aulacantha scolymantha*, Haeckel.

*Aulacantha scolymantha*, Haeckel, 1862, Monogr. d. Radiol., p. 263, Taf. ii. figs. 1, 2, Taf. iv. figs. 1–5.

*Aulacantha scolymantha*, R. Hertwig, 1879, Organism. d. Radiol., p. 88, Taf. ix. fig. 3, Taf. x. figs. 7–10.

Radial tubes cylindrical, straight, of nearly equal breadth throughout their whole length, somewhat inflated on the proximal basal end, smooth throughout the greater part of their length, but in the distal third dentate, with numerous (ten to forty) small pointed teeth, which are curved outwards, and shorter than the thickness of the tube.

*Dimensions.*—Length of the tubes 0·5 to 2·0, breadth 0·01 to 0·02.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific; at many Stations; surface and at various depths; the most common of all Aulacanthida.

2. *Aulacantha tubulosa*, n. sp.

Radial tubes cylindrical or nearly spindle-shaped, straight, gradually tapering towards the two pointed ends, twice as broad in the middle third as in the outer and inner third, smooth in the inner half, dentate in the outer half, with very numerous (one hundred to two hundred) short conical teeth, which are scarcely one-fourth as large as the greatest breadth of the tube.

*Dimensions.*—Length of the tubes 0·4 to 0·5, breadth in the middle part 0·02 to 0·03.

*Habitat.*—Central Pacific, Stations 271 to 274, surface.

3. *Aulacantha spinosa*, n. sp. (Pl. 105, fig. 4).

Radial tubes cylindrical, straight, of equal breadth throughout their whole length, rounded on the proximal base, smooth in the inner proximal half, dentate or spinescent in the outer distal half, with numerous (fifty to eighty) slender conical teeth, which are curved forwards, increasing in size towards the distal end, and somewhat longer than the breadth of the tube.

*Dimensions.*—Length of the tubes 0·8 to 1·2, breadth 0·015 to 0·02.

*Habitat.*—North Pacific, Stations 241 to 253, surface.

4. *Aulacantha cannulata*, n. sp. (Pl. 105, fig. 16).

Radial tubes cylindrical in the inner proximal half, prismatic in the outer distal half, with from three to six, usually four, prominent, thick, parallel edges, which are dentate towards the thicker distal end; their teeth short, conical, directed outwards, scarcely one-fourth as long as the thickness of the tube. The edges are separated in the distal third by more or less deep furrows, like a channelled column.

*Dimensions.*—Length of the tubes 1·2 to 2·5, breadth 0·03 to 0·04.

*Habitat.*—South Pacific, Stations 291 to 293, surface.

5. *Aulacantha clavata*, n. sp.

Radial tubes more or less irregularly curved, in the inner proximal half slenderly conical, and gradually tapering towards the inflated base, in the outer distal half club-shaped, armed with a few (five to twenty) short conical teeth.

*Dimensions.*—Length of the tubes 1·0 to 1·2, breadth in the middle part 0·01, in the distal part 0·04.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

6. *Aulacantha lævissima*, n. sp.

Radial tubes cylindrical, straight, of nearly equal breadth throughout their whole length; the inner proximal end rounded, the outer distal end pointed. Surface of the tubes perfectly smooth, without any teeth. The thickness and length of the simple spicula, as well as the thickness of their wall, are very variable in this species.

*Dimensions.*—Length of the tubes 0·5 to 4·2, breadth 0·003 to 0·02.

*Habitat.*—North Atlantic, Station 253, Færöe Channel, surface, John Murray.

## Genus 667. *Aulographis*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Aulacanthida with a veil of tangential needles, and with radial tubes, which bear no lateral branches, but at the distal end a verticil of simple terminal branches.

The genus *Aulographis*, the richest in the number of species among all Aulacanthida, differs from the preceding *Aulacantha*, its ancestral form, in the development of simple terminal branches, which form either a fork or a verticil. The branches are either smooth or spiny, but not ramified as in the following genus, *Auloceros*. Their distal

[1] *Aulographis*=Tubular style; αὐλός, γραφίς.

ends are either simply pointed or bear a terminal spathilla, or a little crown of recurved teeth. According to these differences we may dispose the twenty-six species described into four subgenera.

## Subgenus 1. *Aulographantha*, Haeckel.

*Definition.*—Terminal branches of the radial tubes simple, smooth, without lateral teeth and terminal spathillæ. Tubes usually thin and fragile.

### 1. *Aulographis pandora*, n. sp. (Pl. 103, figs. 2–9).

Radial tubes cylindrical, slender, straight or slightly curved, of equal breadth. Terminal branches of the tubes very variable in size and number (two to six, usually three or four), without lateral teeth and terminal spathillæ, slender, conical, slightly curved, directed outwards, twice to four times (rarely five to eight times) as long as the breadth of the tubes. This species is extraordinarily variable in the number and size of the simple terminal branches; the eight tubes, shown in figs. 2 to 9, are all found in one and the same specimen.

*Dimensions.*—Length of the tubes 0·5 to 1·5, breadth 0·01 to 0·03; branches 0·02 to 0·12.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific; surface and in various depths.

### 2. *Aulographis bovicornis*, n. sp. (Pl. 103, figs. 12–14).

Radial tubes cylindrical, slender, straight, of equal breadth. Terminal branches usually two (rarely three), smooth, without lateral teeth and terminal spathillæ, eight to ten times as long as the breadth of the tube, pointed, S-shaped, or curved like the horns of an ox.

*Dimensions.*—Length of the tubes 0·6 to 0·8, breadth 0·015 to 0·02; branches 0·1 to 0·2.

*Habitat.*—South Atlantic (east of Buenos Ayres), Stations 323 to 325, surface.

### 3. *Aulographis taumorpha*, n. sp. (Pl. 103, fig. 16).

Radial tubes cylindrical, slender, straight, gradually tapering towards the pointed proximal end. Terminal branches constantly two, opposite in a tangential, slightly concave or nearly straight line, ten to twelve times as long as the breadth of the tube, smooth, straight in the proximal part, recurved in the distal part.

*Dimensions.*—Length of the tubes 0·7 to 0·8, breadth 0·01 to 0·015; branches 0·1 to 0·15.

*Habitat.*—North Pacific, Station 231, depth 2250 fathoms.

4. *Aulographis triglochin*, n. sp. (Pl. 103, fig. 17).

Radial tubes robust, club-shaped at the distal end. Terminal branches three (rarely two or four), widely divergent, geniculated and recurved, smooth, without lateral teeth and terminal spathillæ.

*Dimensions.*—Length of the tubes 1·2 to 1·8, breadth 0·02; branches 0·12 to 0·15.

*Habitat.*—Central Pacific, Stations 271 to 274, surface.

5. *Aulographis cruciata*, n. sp. (Pl. 103, fig. 25).

Radial tubes slender, cylindrical, of equal breadth. Terminal branches almost constantly four, equal, regularly crossed (very rarely three or five), slender, straight or slightly curved, smooth, divergent outwards, six to eight times as long as the breadth of the tube.

*Dimensions.*—Length of the tubes 1·0 to 1·5, breadth 0·02; branches 0·12 to 0·15.

*Habitat.*—South Atlantic, Stations 325 to 332, surface.

6. *Aulographis ancorata*, n. sp. (Pl. 103, fig. 21).

Radial tubes slender, cylindrical, straight. Terminal branches constantly four, equal, regularly crossed, arcuato-recurved or nearly semicircular, smooth; six to eight times as long as the breadth of the tube. Resembling an anchor with four teeth.

*Dimensions.*—Length of the tubes 0·5 to 0·7, breadth 0·012 to 0·015; branches 0·07 to 0·09.

*Habitat.*—South-west Atlantic, Station 318, depth 2040 fathoms.

7. *Aulographis stellata*, n. sp. (Pl. 103, figs. 23, *a–c*).

Radial tubes club-shaped, gradually thickened towards the distal end. Terminal branches stellate, numerous (five to ten or more), diverging in all directions, smooth, straight or slightly curved, slenderly conical, three to five times as long as the distal breadth of the tube. The branches are very variable in size, sometimes very small (figs. *a*, *b*).

*Dimensions.*—Length of the tubes 0·4 to 0·8, breadth 0·02; branches 0·01 to 0·02.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

8. *Aulographis penicillata*, n. sp.

Radial tubes slender, cylindrical, of equal breadth. Terminal branches pencil-shaped, smooth, very numerous (twenty to thirty or more), diverging outwards, curved, eight to ten times as long as the breadth of the tube, very thin and fragile, resembling a brush.

*Dimensions.*—Length of the tubes 1·0 to 1·5, breadth 0·02; branches 0·15 to 0·2.

*Habitat.*—North Atlantic (Antilles), Weber, surface.

9. *Aulographis pistillum*, n. sp. (Pl. 105, fig. 6).

Radial tubes club-shaped, robust, straight, gradually thickened towards the distal end. Terminal branches eight to ten (usually nine), conical, smooth, slightly curved, divergent outwards like a regular corona.

*Dimensions.*—Length of the tubes 0·5 to 0·6, distal breadth 0·04; branches 0·08.

*Habitat.*—North Atlantic, Station 354, depth 1675 fathoms.

## Subgenus 2. *Aulographella*, Haeckel.

*Definition.*—Terminal branches of the radial tubes without terminal spathillæ, but with lateral teeth or secondary spines. (Tubes usually very stout and robust, club-shaped.)

10. *Aulographis triæna*, n. sp. (Pl. 105, fig. 8).

Radial tubes club-shaped, straight, tapering gradually towards the rounded proximal end. Terminal branches constantly three, divergent, very stout, eight to ten times as long as the breadth of the tube, each studded with three to six irregular, conical, secondary spines. Sometimes the branches become forked, the species passing over into *Auloceros cervinus*.

*Dimensions.*—Length of the tubes 1·2 to 1·5, breadth 0·004 to 0·06; branches 0·3 to 0·5.

*Habitat.*—South Pacific, Station 299, depth 2160 fathoms.

11. *Aulographis martagon*, n. sp. (Pl. 105, fig. 7).

Radial tubes club-shaped or slenderly conical, strongly thickened towards the distal end. Terminal branches six to nine, conical, slightly curved, divergent outwards, studded outside with small, conical, secondary spines, twice to three times as long as the breadth of the tube.

*Dimensions.*—Length of the tubes 1·0 to 1·2, breadth 0·04 to 0·05; branches 0·1 to 0·15.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

12. *Aulographis flammabunda*, n. sp. (Pl. 105, fig. 9).

Radial tubes club-shaped, more or less curved, with thickened distal ends. Terminal branches three to six, conical, very stout, three to four times as long as the breadth of the tube, densely studded with numerous, crowded, conical, secondary spines, which are very irregular and more or less curved, resembling the flames of a fire.

*Dimensions.*—Length of the tubes 1·0 to 1·2, distal breadth 0·08 to 0·1; branches 0·2 to 0·4.

*Habitat.*—South Pacific, Station 302, depth 1450 fathoms.

13. *Aulographis gemmascens*, n. sp. (Pl. 105, fig. 11).

Radial tubes club-shaped, more or less curved, with thickened distal end. Terminal branches three to nine (usually three larger and six smaller) stout, conical, studded with irregular, straight, conical, secondary spines, crowded and densely aggregated, like the leaves in a bud.

*Dimensions.*—Length of the spines 1·5 to 1·8, distal breadth 0·07 to 0·1; branches 0·2 to 0·6.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

14. *Aulographis flosculus*, n. sp. (Pl. 105, fig. 10).

Radial tubes club-shaped, straight, tapering gradually towards the rounded proximal end. Terminal branches nine to twelve, stout, conical, twice to three times as long as the breadth of the tube, studded with irregular secondary spines, connected in the proximal half by a solid, cap-shaped, flinty lamella, so that the terminal corona resembles a flower. The hollow canal of the tube sends a thin branch into each branch of the crown.

*Dimensions.*—Length of the tubes 1·2 to 1·8, distal breadth 0·04 to 0·05; branches 0·1 to 0·2.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray, depth 600 fathoms.

## Subgenus 3. *Aulographidium*, Haeckel.

*Definition.*—Terminal branches of the radial tubes armed with terminal spathillæ (or whorls of small radial teeth), but without lateral denticles or spines.

15. *Aulographis furcula*, n. sp. (Pl. 103, figs. 10, 11).

Radial tubes cylindrical, slender, slightly curved. Terminal branches usually two, sometimes on single tubes three, eight to ten times as long as the tube is broad, strongly curved, ascending vertically from a horizontal base, with a terminal spathilla of four crossed teeth at the distal end.

*Dimensions.*—Length of the tubes 0·6 to 0·8, breadth 0·006 to 0·008; branches 0·06 to 0·08.

*Habitat.*—North-west Pacific (off Japan), Station 231, depth 2250 fathoms.

16. *Aulographis triangulum*, n. sp. (Pl. 103, fig. 15).

Radial tubes cylindrical, slender, straight. Terminal branches constantly three, slender, slightly curved, nearly horizontally (tangentially) expanded, eight to ten times as long as the tube is broad, with a terminal spathilla of four recurved teeth which are opposite in pairs. Since the angles between the three branches are equal (=120°) they correspond to the axes of an equilateral triangle.

*Dimensions.*—Length of the tubes 1·2, breadth 0·015 to 0·02; branches 0·1 to 0·12.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

17. *Aulographis tetrancistra*, n. sp. (Pl. 103, fig. 22).

Radial tubes slender, cylindrical, straight. Terminal branches four to six (usually four), eight to ten times as long as the tube is broad, slightly curved and widely divergent, with a terminal spathilla of four crossed recurved teeth.

*Dimensions.*—Length of the tubes 0·5 to 0·7, breadth 0·01; branches 0·08 to 0·1.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

18. *Aulographis hexancistra*, n. sp. (Pl. 103, figs. 18, 19).

Radial tubes club-shaped, slightly curved, gradually thickened from the proximal to the distal end. Terminal branches four to eight (usually six in the majority of tubes), widely divergent, nearly straight, three to four times as long as the tube is broad, with a terminal spathilla of six (rarely five) recurved teeth.

*Dimensions.*—Length of the tubes 0·4 to 0·6, breadth 0·01 to 0·02; branches 0·04 to 0·08.

*Habitat.*—North Pacific, Stations 244 to 253, depth 2050 to 3125 fathoms.

19. *Aulographis polyancistra*, n. sp.

Radial tubes club-shaped, straight, thickened towards the distal end. Terminal branches ten to twenty, smooth, strongly curved, disposed in a corona, six to eight times as long as the tube is broad, each with a terminal spathilla of eight to twelve radial teeth.

*Dimensions.*—Length of the tubes 0·6 to 0·8, distal breadth 0·02; branches 0·12 to 0·16.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

20. *Aulographis asteriscus*, n. sp. (Pl. 103, fig. 24).

Radial tubes slender, cylindrical, straight, equally broad. Terminal branches six to nine, widely divergent, disposed in a radiate corona around a central branch, which is the distal prolongation of the tube itself. Each branch bears a stellate terminal spathilla, composed of ten to twenty conical teeth, which radiate in all directions.

*Dimensions.*—Length of the tubes 0·5 to 0·8, breadth 0·02; branches 0·06 to 0·09.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

## Subgenus 4. *Aulographonium*, Haeckel.

*Definition.*—Terminal branches of the radial tubes armed with numerous lateral denticles, and with terminal spathillæ (or whorls of small radial teeth).

21. *Aulographis dentata*, n. sp. (Pl. 103, fig. 20).

Radial tubes slender, cylindrical, equally broad, scarcely inflated at the distal end. Termina branches six to eight, curved, disposed in a corona around a straight central branch, eight to ten times as long as the tube is broad, armed with numerous stout recurved lateral denticles and with a terminal spathilla of five or six recurved teeth.

*Dimensions.*—Length of the tubes 1·5 to 2·5, breadth 0·03; branches 0·15 to 0·2 long.

*Habitat.*—North Atlantic, Station 354, depth 1675 fathoms.

22. *Aulographis pulvinata*, n. sp. (Pl. 103, fig. 26).

Radial tubes club-shaped, straight, gradually thickened towards the distal end, which bears a broad, circular, biconvex cushion. The margin of this cushion bears two alternating verticils of radially divergent, straight, terminal branches, which are twice to three times as long as the tube is broad. Each branch is armed with two opposite lateral rows of numerous small denticles, and bears a terminal spathilla with six to eight recurved radial teeth.

*Dimensions.*—Length of the tubes 2·0 to 2·4, distal breadth 0·03 to 0·07; branches 0·05 to 0·08 long.

*Habitat.*—South-east Pacific (off Valparaiso), Station 298, depth 2225 fathoms.

23. *Aulographis tripentas*, n. sp. (Pl. 105, fig. 13, 13*a*).

Radial tubes club-shaped, straight, thickened towards the inflated distal end, which bears three alternating verticils of terminal branches, each with five radial branches. The ten branches of the inner and outer verticils are perradial, smooth; the alternating five branches of the middle verticil are armed with recurved lateral denticles. Each of the fifteen branches bears a terminal spathilla with five to seven recurved teeth.

*Dimensions.*—Length of the spines 2·0 to 2·5, distal breadth 0·03 to 0·06; branches 0·1 long.

*Habitat.*—South-east Pacific (off Juan Fernandez), Station 299, depth 2160 fathoms.

24. *Aulographis verticillata*, n. sp. (Pl. 105, fig. 12, 12*a*).

Radial tubes cylindrical, equally broad, with an inflated ellipsoidal knob at the distal end. This knob bears twenty to thirty slender, slightly curved, terminal branches, which are regularly arranged in five radial or meridional rows, and in four to six concentric verticils. The branches are five to ten times as long as the tube is broad, and armed with two opposite rows of lateral denticles, and with a terminal spathilla of six to eight recurved teeth.

*Dimensions.*—Length of the tubes 1·5 to 1·8, breadth 0·01 to 0·02; branches 0·5 to 1·0 long.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

25. *Aulographis serrulata*, n. sp. (Pl. 103, fig. 27).

Radial tubes club-shaped, curved, thickened towards the inflated ellipsoidal distal end, which bears a bunch of fifteen to twenty-five terminal branches, arranged more or less regularly in radial

or meridional rows and concentric horizontal verticils. The branches are irregularly curved, twice to four times as long as the distal end of the tube, armed with two opposite rows of lateral denticles, and at the distal end with a spathilla of six radial teeth.

*Dimensions.*—Length of the tubes 1·5 to 1·8, breadth 0·02 to 0·04; branches 0·1 to 0·15 long.

*Habitat.*—North Pacific, Stations 253 and 254, depth 3025 to 3125 fathoms.

26. *Aulographis candelabrum*, n. sp. (Pl. 103, fig. 1).

Radial tubes club-shaped, straight, thickened towards the distal end and constricted beyond the ovate, inflated, terminal knob. This knob is similar to a candelabrum and bears a corona of six to nine strongly curved terminal branches, which are eight to ten times as long as the tube is broad, armed with scattered lateral denticles, and with a spathilla of five to seven radial teeth.

*Dimensions.*—Length of the tubes 1·6 to 2·4, breadth 0·03 to 0·05; branches 0·2 to 0·3 long.

*Habitat.*—South-east Pacific (off Juan Fernandez), Station 300, depth 1375 fathoms.

## Genus 668. *Auloceros*,[1] n. gen.

*Definition.*—Aulacanthida with a veil of tangential needles, and with radial tubes, which bear no lateral branches, but at the distal end a verticil of ramified or forked terminal branches.

The genus *Auloceros* differs from the preceding closely allied *Aulographis*, its ancestral form, in the ramification of the verticillate terminal branches. They are either simply forked or again ramified, and their distal ends are either simply pointed or armed with a terminal spathilla, or a little crown of recurved teeth. Some forms of this genus belong to the most elegant and graceful PHÆODARIA, as the *Auloceros elegans* figured, which I observed living in the Indian Ocean.

### Subgenus 1. *Auloceræa*, Haeckel.

*Definition.*—Distal ends of the terminal branches pointed, smooth, without spathilla (or corona of radiate denticles).

1. *Auloceros furcosus*, n. sp. (Pl. 102, figs. 2–6).

Radial tubes slender, spindle-shaped or nearly cylindrical, more or less tapering towards the two ends. Terminal branches slender, curved, twice to four times as long as the tube is broad, very variable in number (usually two or three, rarely four, five, or six; compare figs. 2–6), once or twice forked; the secondary branches are short, irregular, and pointed. No terminal spathillæ.

[1] *Auloceros* = Tubular horn; αὐλός, κέρως.

In some specimens of this species all the tubes bear two or three terminal branches, whilst in others there are tubes with four, five, or six branches intermingled. When the number of the terminal branches is constant in single localities, this transformistic or "Darwinian" species may be divided into the following "subspecies:" (1) *Auloceros pandora* (with variable numbers); (2) *Auloceros bifurca* (fig. 2); (3) *Auloceros trifurca* (fig. 3); (4) *Auloceros quadrifurca* (fig. 4); (5) *Auloceros quinquefurca* (fig. 5); (6) *Auloceros scæfurca* (fig. 6).

*Dimensions.*—Length of the tubes 1·5 to 2·5, breadth 0·02 to 0·03; branches 0·05 to 0·15 long.

*Habitat.*—North Pacific, Stations 231 to 253, surface and at various depths.

2. *Auloceros trigeminus*, n. sp. (Pl. 102, fig. 7).

Radial tubes club-shaped, gradually thickened towards the inflated distal end. Terminal branches short, scarcely longer than the tube is broad, two constantly opposite, each with three equal, conical, short secondary branches. No terminal spathillæ.

*Dimensions.*—Length of the tubes 0·6 to 0·8, breadth 0·02 to 0·03; branches 0·04 to 0·08.

*Habitat.*—North Atlantic, Station 353, depth 2965 fathoms.

3. *Auloceros capreolus*, n. sp. (Pl. 102, fig. 8).

Radial tubes cylindrical, equally broad. Terminal branches in two opposite clustered bunches, each with sixteen to eighteen unequal secondary branches. The total length and breadth of each cluster is about four times as great as the tube is broad. No terminal spathillæ.

*Dimensions.*—Length of the tube 1·5 to 2·0, breadth 0·03; branches 0·07 to 0·1.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

4. *Auloceros cervinus*, n. sp. (Pl. 102, figs. 9, 10).

Radial tubes slender, spindle-shaped, slightly curved, tapering gradually from the middle towards the two ends. Terminal branches constantly three, obliquely ascending, each twice or three times forked (often more or less irregularly), with slender, curved, secondary and tertiary branches (twenty to twenty-four on each tube); the latter are scarcely half as broad as the three main branches of each tube. No terminal spathillæ.

*Dimensions.*—Length of the tubes 2·0 to 3·5, breadth 0·03 to 0·04; branches 0·12 to 0·15 long.

*Habitat.*—South Atlantic, Station 325, depth 2650 fathoms.

5. *Auloceros elegans*, n. sp. (Pl. 102, fig. 1).

Radial tubes slender, cylindrical, straight, equally broad. Terminal branches two or three, more or less irregularly branched, each with twelve to eighteen curved and pointed secondary branches. No terminal spathillæ. Differs from the preceding *Auloceros cervinus* in the cylindrical form of the thinner straight tubes, and the more irregular ramification; the branches are nearly

tangentially expanded. The specimen figured, with expanded pseudopodia, red central capsule, and green phæodium, was observed living by me in 1882 in Ceylon.

*Dimensions.*—Length of the tubes 1·0 to 2·0, breadth 0·02 to 0·03; branches 0·15 to 0·3.

*Habitat.*—Indian Ocean, Ceylon (south of Matura), Haeckel, surface.

### Subgenus 2. *Auloceratium*, Haeckel.

*Definition.*—Distal ends of the terminal branches with a spathilla, or a small corona of radial, usually recurved teeth.

#### 6. *Auloceros dicranaster*, n. sp. (Pl. 105, figs. 14, 15).

Radial tubes cylindrical, straight, equally broad. Terminal branches tangential, forked, expanded horizontally, five to six times as long as the tube is broad; their number is usually five (more rarely four or six), and each is divided into two short, equal, divergent, secondary branches, armed at the distal end with a spathilla of five or six unequal recurved teeth.

*Dimensions.*—Length of the tubes 1·0 to 1·5, breadth 0·01 to 0·02; branches 0·05 to 0·08.

*Habitat.*—North Pacific, Stations 244 to 252, depth 2050 to 3050 fathoms.

#### 7. *Auloceros spathillaster*, n. sp. (Pl. 102, fig. 12).

Radial tubes club-shaped or nearly cylindrical, straight, often thickened towards the distal end. Terminal branches ascending, three to six, usually four, partly simple, partly forked, slightly curved. The branches are from twice to three times as long as the tube is broad, and much thinner; at the distal end they are armed with a spathilla of five or six recurved teeth.

*Dimensions.*—Length of the tubes 2·0 to 2·5, breadth 0·02 to 0·03; branches 0·08 to 0·12.

*Habitat.*—South Atlantic, Station 319, depth 2425 fathoms.

#### 8. *Auloceros arborescens*, n. sp. (Pl. 102, figs. 11, 13).

Radial tubes club-shaped, irregularly curved, thickened towards the distal end. Terminal branches two opposite (rarely three or four), forked near the base, and either dichotomously or more irregularly branched; each tube bears fifteen to thirty, usually twenty to twenty-four, secondary branches, which are irregularly curved, and armed at the distal end with a spathilla of four to eight recurved teeth. The tubes are more richly branched than in the preceding, smaller, closely allied species, and the branches are more flatly expanded.

*Dimensions.*—Length of the tubes 2·6 to 3·3, breadth 0·03 to 0·04; branches 0·1 to 0·2.

*Habitat.*—South Pacific, Stations 288 to 295, depth 1500 to 3000 fathoms.

Genus 669. *Aulospathis*,[1] n. gen.

*Definition.*—Aulacanthida with a veil of tangential needles, and with radial tubes, which bear two verticils of branches, a distal verticil of terminal branches, and a proximal verticil of lateral branches.

The genus *Aulospathis* and the following *Aulodendron* differ from the preceding Aulacanthida in the possession of lateral branches; these are usually similar to the terminal branches, and irregularly scattered along the distal half of the tubes in *Aulodendron*. In *Aulospathis*, however, the largest form in the family, each tube bears two whorls or verticils only, a verticil of terminal branches at the distal end, and a verticil of lateral branches beyond the latter, between the middle and distal third of the tube. The number of branches in each verticil is usually from two to four, rarely more; it is, however, very variable, so that the ten species described in the sequel are "Darwinian species," derived either from *Aulospathis polymorpha* or from *Aulospathis variabilis*. Each branch bears at the distal end a spathilla, the teeth of which are very variable in form, number and arrangement.

Subgenus 1. *Aulospathessa*, Haeckel.

*Definition.*—Distal ends of the radial tubes inflated, usually in the form of an ovate or pyriform terminal knob.

1. *Aulospathis bifurca*, n. sp. (Pl. 104, figs. 1–5).

Radial tubes with an inflated ovate terminal knob at the distal end, which bears two divergent, curved, terminal branches (often a few tubes bear three or four branches instead of the usual two). Proximal whorl usually cruciate, with four irregularly crossed lateral branches (but often with five or six, more rarely with two or three).

*Dimensions.*—Length of the tubes 0·15 to 25 mm., breadth 0·04 to 0·06; branches 0·1 to 0·15.

*Habitat.*—South Pacific, Stations 293 to 295, depth 1500 to 2270 fathoms.

2. *Aulospathis trifurca*, n. sp. (Pl. 104, figs. 6, 7, 7*a*).

Radial tubes with an inflated ovate terminal knob at the distal end, which bears three divergent, straight, or slightly curved terminal branches (often a few tubes bear two or four branches instead of the usual three). Proximal whorl irregular, usually with six divergent, straight, lateral branches.

*Dimensions.*—Length of the tubes 2·2 to 3·4, breadth 0·03 to 0·05; branches 0·1 to 0·15.

*Habitat.*—South Pacific (off Valparaiso), Stations 298 to 300, depth 1375 to 2225 fathoms.

[1] *Aulospathis*=Tube with whirls; *αὐλός, σπαθίς.*

3. *Aulospathis quadrifurca*, n. sp.

Radial tubes with an inflated ovate terminal knob at the distal end, which bears four crossed, divergent, curved terminal branches. Proximal whorl also rather regular, with a cross of four straight lateral branches.

*Dimensions.*—Length of the tubes 3·0 to 4·0, breadth 0·04 to 0·08; branches 0·2 to 0·3.

*Habitat.*—South Pacific, Station 291, depth 2250 fathoms.

4. *Aulospathis polymorpha*, n. sp. (Pl. 104, figs. 10–13).

Radial tubes with an inflated ovate terminal knob at the distal end, which bears a variable number of divergent, curved, irregular, terminal branches. Usually the majority of the tubes bear three branches, whilst others exhibit two or four, sometimes also five or six. Proximal whorl also very variable and irregular, with two to six, usually three or four unequal branches.

*Dimensions.*—Length of the tubes 2·0 to 4·0, breadth 0·04 to 0·06; branches 0·1 to 0·3.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

## Subgenus 2. *Aulospathilla*, Haeckel.

*Definition.*—Distal ends of the radial tubes of equal breadth or tapering gradually, not inflated, without terminal knobs.

5. *Aulospathis diodon*, n. sp.

Radial tubes without inflated terminal knob, forked at the tapering distal end, with two divergent curved branches of equal size. Proximal whorl cruciate, with four rather equal, crossed, straight, lateral branches (sometimes three or five instead of four in single tubes).

*Dimensions.*—Length of the tubes 2·0 to 2·5, breadth 0·03 to 0·04; branches 0·1 to 0·3.

*Habitat.*—North Pacific, Station 231, depth 2250 fathoms.

6. *Aulospathis triodon*, n. sp. (Pl. 104, fig. 8).

Radial tubes without inflated terminal knob, with three divergent, slightly curved, terminal branches. Proximal whorl with a variable number of curved lateral branches, usually also three (often two or four, rarely more).

*Dimensions*—Length of the tubes 2 to 3, breadth 0·03 to 0·05; branches 0·2 to 0·3.

*Habitat.*—North Pacific, Stations 250 to 253, depth 2740 to 3125 fathoms.

7. *Aulospathis tetrodon*, n. sp. (Pl. 104, fig. 9).

Radial tubes without inflated terminal knob, with four crossed, divergent, slightly curved terminal branches. Proximal whorl usually with an irregular cross of four lateral branches (often five or six, rarely two or three instead of the usual four).

*Dimensions.*—Length of the tubes 2·0 to 2·5, breadth 0·03 to 0·04; branches 0·2 to 0·3.

*Habitat.*—North Pacific, Stations 244 to 245, depth 2775 to 2900 fathoms.

8. *Aulospathis hexodon*, n. sp.

Radial tubes without inflated terminal knob, with three forked, curved branches at the distal end, so that each tube usually bears six terminal branches; but other tubes of the same specimen bear only three simple or a few irregularly forked branches. Proximal whorl usually with six curved, irregular, lateral branches.

*Dimensions.*—Length of the tubes 2·0 to 3·0, breadth 0·03 to 0·06; branches 0·2 to 0·5.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

9. *Aulospathis furcata*, n. sp.

Radial tubes without inflated terminal knob, with a variable number of unequal terminal branches, which are partly simple, partly irregularly forked or branched; the usual number of terminal branches is three or four, more rarely two or five or six. Proximal whorl very irregular, usually with four to six unequal, lateral branches.

*Dimensions.*—Length of the tubes 2·0 to 2·5, breadth 0·03 to 0·05; branches 0·1 to 0·3.

*Habitat.*—Stations 265 to 268, depth 2700 to 2900 fathoms.

10. *Aulospathis variabilis*, n. sp. (Pl. 104, figs. 14–17).

Radial tubes without inflated terminal knob, with a variable number of unequal terminal branches, which are constantly simple, never forked; the usual number is in the majority of the tubes three or four, often also two, rarely five to eight. Proximal whorl irregular, with a variable number of lateral branches (usually four to six).

*Dimensions.*—Length of the tubes 2·0 to 3·0, breadth 0·03 to 0·06; branches 0·1 to 0·3.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

## Genus 670. *Aulodendron*,[1] n. gen.

*Definition.*—Aulacanthida with a veil of tangential needles, and with radial tubes, which bear numerous, irregularly scattered, lateral and terminal branches.

[1] *Aulodendron* = Tubular tree; αὐλός, δένδρον.

The genus *Aulodendron* differs from the other Aulacanthida in the possession of lateral and terminal branches, which are irregularly scattered on the radial tubes and not arranged in regular verticils. The branches are usually short, simple or forked, rarely longer and again irregularly ramified.

1. *Aulodendron antarcticum*, n. sp. (Pl. 105, fig. 5).

Radial tubes cylindrical, more or less curved, in the inner proximal half smooth and half as broad as in the outer distal half, which is studded with irregularly curved, partly branched spines, arising usually perpendicularly from the tube. The majority of the spines usually simple, the minority forked, with two to four short branches, the largest spines scarcely twice as long as the breadth of the tube.

*Dimensions.*—Length of the tubes 0·7 to 0·9, breadth 0·01 to 0·02; length of the branches 0·02 to 0·04.

*Habitat.*—Antarctic Ocean (Kerguelen), Stations 156 to 159, surface.

2. *Aulodendron pacificum*, n. sp. (Pl. 105, fig. 2).

Radial tubes cylindrical, slightly curved, in the proximal half smooth, in the distal half with scattered lateral branches, which are partly simple, partly forked, about twice as long as the breadth of the tube, and bear at the distal end a spathilla with five to six recurved teeth. The distal end of the tubes bears a spherical knob, which is separated by a deep stricture and armed with a bunch of six to twelve strong conical teeth.

*Dimensions.*—Length of the tubes 1 to 1·2, breadth 0·015 to 0·02; branches 0·03 to 0·04.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

3. *Aulodendron australe*, n. sp. (Pl. 105, fig. 3).

Radial tubes cylindrical, straight, thin, smooth in the proximal half, armed with numerous lateral branches in the distal half; the majority of the branches forked, about as long as the breadth of the tube, with two or three short ramules, each of which bears a spinulate terminal knob. The distal end of the tubes also forked, with two or three divergent branches.

*Dimensions.*—Length of the tubes 1·2 to 1·6, breadth 0·01 to 0·012.

*Habitat.*—South Pacific, Station 289; New Zealand, Station 169, surface.

4. *Aulodendron atlanticum*, n. sp.

Radial tubes cylindrical, tapering gradually towards the two ends; smooth and straight in the proximal half, irregularly curved and branched in the distal half, with ten to twenty (rarely more) branches, which arise almost perpendicularly from the tube. The proximal branches are from four to eight times as long as the greatest breadth of the tube, forked, with two or three short ramules;

the distal branches are much smaller and simple. The distal end of each branch bears a spathilla with four to six short teeth.

*Dimensions.*—Length of the tubes 2·4 to 3·6, breadth 0·06 to 0·08.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

5. *Aulodendron indicum*, n. sp. (Pl. 105, fig. 1).

Radial tubes cylindrical, irregularly curved, tapering gradually towards the two ends; smooth in the proximal half, irregularly branched in the distal half, with ten to twenty or more curved branches. The proximal branches are very large, one-sixth to one-fourth as long as the tube and irregularly ramified; the distal branches are much shorter, also ramified or simple. All the branches are more or less curved and bear a spinulate knob at the distal end.

*Dimensions.*—Length of the tubes 1·2 to 1·8, breadth 0·02 to 0·03; length of the branches 0·1 to 0·3.

*Habitat.*—Indian Ocean; Cocos Islands (Rabbe), surface.

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## Order II. PHÆOSPHÆRIA, Haeckel, 1879.

*Definition.*—PHÆODARIA with a simple or double, usually spherical lattice-shell, which is not bivalved and has no peculiar mouth or peristome. Central capsule placed in the centre of the shell.

### Family LXXIV. OROSPHÆRIDA, n. fam. (Pls. 106, 107).

*Definition.*—PHÆODARIA with a big spherical (sometimes polyhedral or ellipsoidal), very coarse shell, which is composed of thick bars containing an axial canal. Nodal points of the coarse network without astral septa. Meshes of moderate size, irregularly polygonal. Surface of the shell usually with radial spines and pyramidal elevations. No peculiar mouth in the shell. Central capsule tripylean, in the centre of the shell.

The family Orosphærida comprises those PHÆODARIA which possess a simple spherical or polyhedral lattice-shell, composed of hollow, very thick, non-articulate rods, without a peculiar shell-mouth. They agree in the considerable size of the spherical lattice-shell and the absence of a peculiar shell-mouth with the other Phæosphæria, but differ from them in the coarse and irregular shape of the massive network, which is composed of irregular polygonal meshes, separated by very thick concentrically stratified rods, containing a fine axial canal. The closely allied Sagosphærida differ from them in the delicate shape of the solid and very thin, filiform rods of the network, and its subregular

triangular meshes. The Aulosphærida differ in the development of the peculiar nodal cavities and astral septa, by which the thin-walled cylindrical tubes of the articulated network are separated in the stellate nodal points. The Cannosphærida, closely allied to these latter, also differ in the articulated network, and further in the possession of an internal concentric shell. The Castanellida are sometimes similar to the Orosphærida, but distinguished by a peculiar large shell-mouth and a network of different shape.

The Orosphærida belong to the biggest Radiolaria, and the lattice-work of their spherical shell is of a ruder and coarser shape than in any of the other families of this class. Nevertheless they have been hitherto perfectly unknown, and were first discovered by the Challenger. We have been able to distinguish in the collection four genera and twenty-seven species. This strange fact may be explained by the circumstance, that they are in general rare, and restricted to a few localities, and that probably all the species are inhabitants of great depths. Complete shells also are rarely found, whilst broken fragments of their big shells, easily recognisable by the coarse irregular meshes and the thick stratified bars, are met with frequently in the Radiolarian ooze of some Pacific Stations, especially at Stations 265 and 268, at a depth of 2900 fathoms.

The lattice-shell of the Orosphærida is usually spherical, or an endospherical polyhedron (Pl. 106, fig. 4); rarely one axis is somewhat prolonged, so that the shell becomes slightly ellipsoidal (Pl. 106, fig. 1). Its diameter is usually between 2 and 3, often also between 2 and 1 mm., rarely more than 3, or less than 1 mm. The largest shells observed attained 5 to 6, the smallest 0·5 to 0·6 mm. Their general habit is very characteristic, so that they may be easily distinguished from all other spherical lattice-shells, especially from the Castanellida and from the simple Monosphærida (*Cenosphera*, *Acanthosphæra*), with which I confounded them in the beginning (hence the first shell observed, figured in 1878, was placed among the Monosphærida in Pl. 12). A closer examination of the coarse network and of the peculiar structure of its thick bars always enables one to recognise even small isolated fragments of broken shells.

The meshes of the coarse network exhibit in all observed Orosphærida a very irregular form and unequal size; the majority are usually more or less quadrangular, more rarely they are triangular, pentagonal or hexagonal, very rarely rounded. They are often arranged in parallel rows, which seem to be determined by prominent crests, connecting the bases of the radial spines (Pl. 12, fig. 1; Pl. 106, fig. 4, &c.). The diameter of the meshes is usually between 0·05 and 0·1, often 0·1 to 0·2, rarely more than 0·25, or less than 0·025 mm. In *Oroplegma*, which develops an outer loose, spongy shell around the inner primary shell, the big meshes of the former become much larger and very irregular (Pl. 107, fig. 1).

The coarse bars which separate the large meshes of the irregular network are very thick and massive, cylindrical, usually of unequal thickness, straight or slightly curved, never angular or prismatic. Their diameter is usually between 0·01 and 0·02, rarely

more than 0·03 or less than 0·005 mm. Their surface is either smooth or slightly spinulate. Examined in the dry state and by strong lenses, they constantly exhibit a fine, but distinct longitudinal striation, as the expression of concentric stratification. A fine axial canal or central tubule is usually visible in the axis of each rod, and often this axial canal is studded with numerous short lateral branches (Pl. 107, figs. 2, 4, 8). But very often the axial canals become rudimentary or lost, or are developed only in a part of the bars (Pl. 12, fig. 1). When they are completely developed, the entire network of the shell is drained by a reticulate system of communicating axial canals; they are probably filled by jelly in the living body. This tubular system never attains that regularity and high development which is constantly found in the Aulosphærida; and the characteristic stellate nodal points of the latter, with their astral septa, are never found in any of the Orosphærida. Moreover the wall of the tubular bars is very thin and structureless in the Aulosphærida, very thick and stratified in the Orosphærida, the enclosed canal very wide in the former, very narrow in the latter. The stratification of the concentric cylindrical lamellæ, which surround the narrow axial canal, is effected by the gradual deposition of the concentric layers, and is very similar to that which is found in the thick spicula of many sponges. The peculiar structure of the bars in the Orosphærida becomes very distinct if the skeleton be burned, or acted upon by fire for some time; it then assumes a brown colour and its surface often appears dimpled. Sometimes the concave dimples on the surface of the bars are rather deep and separated by prominent crests (Pl. 107, figs. 4, 7). The few genera of Orosphærida which are here distinguished have all the same structure, are closely allied, and differ mainly in the shape of the outer surface of the lattice-sphere. The latter is quite simple and smooth only in *Orona*. In the common *Orosphæra* (Pl. 106, figs. 1–3) it is studded with radial spines. In the most frequent form, *Oroscena*, the shell has a pyramidal or tent-shaped elevation on the base of each radial spine, and usually the bases of the neighbouring spines are connected by strong prominent crests, the edges of the three-sided or four-sided pyramids (Pl. 12, fig. 1; Pl. 106, fig. 4). This remarkable form is more or less polyhedral, with concave sides, and is similar to the characteristic shells which are represented by *Auloscena* among the Aulosphærida, by *Sagoscena* and *Sagoplegma* among the Sagosphærida (compare Pls. 108 and 110). The pyramids or tents, however, are in these latter more regularly and distinctly developed than in the Orosphærida. The radial spines which arise from the top of the pyramids are often branched, and the branches become connected to form an outer enveloping secondary shell or a loose spongy framework in *Oroplegma* (Pl. 107, fig. 1).

The radial spines of the Orosphærida never exhibit a constant number or disposition in the individual species; their usual number is from twenty to sixty. Their form exhibits two different types, which, however, are not sharply separated; robust club-shaped and slender rod-shaped spines. The robust club-shaped spines are usually about as long as

the diameter of the shell; they are longitudinally striped in the basal part, spinulate or reticulately dimpled in the distal part; sometimes they are straight, at other times curved or undulate (Pl. 106, figs. 1–4; Pl. 107, figs. 4–6). The slender rod-shaped spines are usually longer than the diameter of the shell, cylindrical, more or less curved or even undulate, smooth or thorny, sometimes irregularly branched, and often the branches are all or partly connected (Pl. 106, fig. 3; Pl. 107, fig. 1). In the majority of the shells observed the radial spines were found to be partly broken off. Their structure is the same as that of the bars of the network; but the central axial canal and the surrounding concentric lamellæ are usually more distinct than in the latter.

The central capsule of the Orosphærida lies in the centre of the spherical lattice-shell, surrounded by the voluminous calymma, which fills up its cavity. The form, structure, and size of the central capsule are the same as in the closely allied Aulosphærida (Pl. 111, fig. 2). Its diameter is usually about 0·2, or between 0·15 and 0·25, rarely more than 0·3 or less than 1·2. The dark phæodium is of about the same volume as the central capsule, and envelops its oral half with the radiate operculum and the proboscis of the astropyle. The two opposite parapylæ are small.

*Synopsis of the Genera of Orosphærida.*

| | | |
|---|---|---|
| I. Subfamily Oronida. Surface of the shell without pyramidal or tent-shaped elevations. | Surface smooth, without radial spines, | 671. *Orona.* |
| | Surface studded with simple or branched radial spines, | 672. *Orosphæra.* |
| II. Subfamily Oroscenida. Surface of the shell with numerous pyramidal or tent-shaped elevations. | Pyramids of the surface free, without spongy envelope, | 673. *Oroscena.* |
| | Pyramids of the surface connected by a spongy envelope or an external lattice-shell, | 674. *Oroplegma.* |

Genus 671. *Orona*,[1] n. gen.

*Definition.*—Orosphærida with a simple spherical or slightly ellipsoidal shell, without pyramidal elevations and radial spines.

The genus *Orona* is the simplest of the Orosphærida, and probably the common ancestral form of this family. The lattice-shell is a simple fenestrated sphere, sometimes slightly ellipsoidal, with prolonged main axis, and bears on its surface neither tent-shaped elevations nor radial spines. It may be confounded with some big forms of *Cenosphæra*; it differs, however, in the possession of hollow central canals in the thick bars of the very coarse lattice-plate.

[1] *Orona* = Hilly or tuberculate shell; ὄρος, ὰνή.

1. *Orona maxima*, n. sp. (Pl. 107, fig. 5).

Shell spherical, with very irregular polygonal meshes. Bars of the loose network smooth or slightly spinulate, very thick, with a pinnulate axial canal.

*Dimensions.*—Diameter of the sphere 5·0 to 5·5, of the meshes 0·2 to 0·4, of the bars 0·01.

*Habitat.*—Central Pacific, Station 265, depth 2900.

2. *Orona robusta*, n. sp.

Shell spherical, with irregular quadrangular meshes (intermingled with single triangular, pentagonal, and hexagonal meshes). Bars of the coarse network very thick, spinulate.

*Dimensions.*—Diameter of the sphere 3·0 to 3·6, of the meshes 0·05, of the bars 0·012.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

3. *Orona crassissima*, n. sp. (Pl. 107, fig. 7).

Shell ellipsoidal, slightly prolonged in the main axis, with irregular polygonal meshes of very different sizes and unequal forms. Bars of the coarse network very thick, thorny and dimpled, their surface being covered with a network of prominent polygonal crests.

*Dimensions.*—Diameter of the sphere 3·0 to 4·0, of the meshes 0·2 to 0·5, of the bars 0·02 to 0·06.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

## Genus 672. *Orosphæra*,[1] n. gen.

*Definition.*—Orosphæridа with a simple, spherical (sometimes slightly ellipsoidal or polyhedral) lattice-shell without pyramidal elevations, but with numerous radial spines.

The genus *Orosphæra* differs from the preceding *Orona*, its ancestral form, in the development of simple or branched radial spines. It bears, therefore, the same relation to the latter that *Acanthosphæra* has to *Cenosphæra*. In the two latter genera, however, the bars of the network are solid, in the two former hollow. The species referred to *Orosphæra* are closely allied and require a further accurate examination.

### Subgenus 1. *Oronium*, Haeckel.

*Definition.*—Radial spines simple, smooth or spiny, but neither branched nor arborescent.

[1] *Orosphæra*=Sphere with hilly elevations; ὄρος, σφαῖρα.

1. *Orosphæra hastigera*, n. sp.

Radial spines cylindrical, straight, smooth, simple, about as long as the diameter of the spherical shell, and as broad as its smooth bars. Meshes of the network irregularly polygonal, the majority quadrangular, of different sizes.

*Dimensions.*—Diameter of the sphere 1·0 to 1·2, length of the radial spines 1·1 to 1·5, middle breadth 0·004.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

2. *Orosphæra spinigera*, n. sp.

Radial spines cylindrical, irregularly curved, thorny, simple, two to three times as long as the diameter of the spherical shell, and as broad as its spiny bars. Meshes of the network irregularly polygonal, the majority pentagonal.

*Dimensions.*—Diameter of the sphere 1·5 to 1·8, length of the spines 3·0 to 5·0, breadth 0·006.

*Habitat.*—North Atlantic, Station 353, depth 2965 fathoms.

3. *Orosphæra fusigera*, n. sp.

Radial spines slender, spindle-shaped, straight, smooth, about as long as the diameter of the spherical or slightly ellipsoidal shell, in the thicker middle part five times as broad as the bars, and tapering equally towards both ends. Meshes of the network irregularly polygonal, the majority quadrangular, separated by smooth bars.

*Dimensions.*—Diameter of the shell 1·0 to 1·2, length of the spines 1·2 to 1·6, basal breadth 0·02, middle breadth 0·1.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

4. *Orosphæra foveolata*, n. sp.

Radial spines spindle-shaped, straight, dimpled, half as long as the radius of the spherical shell and three to five times as thick as the bars. Meshes irregular, polygonal, of very different shapes, separated by dimpled bars. (Similar to *Oroscena gegenbauri*, Pl. 106, fig. 4, but with spherical dimpled shell, without pyramidal elevations.)

*Dimensions.*—Diameter of the shell 2·0 to 2·4, length of the spines 0·05, breadth 0·15.

*Habitat.*—Central Pacific, Station 267, depth 2700 fathoms.

5. *Orosphæra serpentina*, n. sp. (Pl. 106, fig. 1).

Radial spines cylindrical, dimpled, undulate or curved in a snake-like manner, about as long as the diameter of the ellipsoidal or spherical shell and four to six times as broad as its smooth bars. Meshes very irregular, polygonal.

*Dimensions.*—Diameter of the shell 1·0 to 1·2, length of the spines 0·12 to 0·15, breadth 0·12.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

6. *Orosphæra horrida*, n. sp. (Pl. 106, fig. 2).

Radial spines club-shaped, very strong, straight, about as long as the diameter of the polyhedral shell, ovate and smooth in the distal half, slenderly conical, and armed with recurved spines in the proximal half; their outer third is the thickest, and five times as broad as the smooth bars of the coarse network. Meshes of the latter irregularly quadrangular.

*Dimensions.*—Diameter of the shell 1·2 to 1·6, length of the spines 1·2 to 2·0, breadth 0·2.

*Habitat.*—South Pacific, Station 291, depth 2250 fathoms.

7. *Orosphæra clavigera*, n. sp.

Radial spines club-shaped, thickened towards the distal end, more or less curved, spinulate, about as long as the diameter of the spherical shell; in the distal third four to six times as broad as the spinulate bars. Meshes irregularly polygonal, the majority pentagonal.

*Dimensions.*—Diameter of the shell 2·0 to 2·5, length of the spines 1·8 to 2·2, breadth 0·16.

*Habitat.*—Central Pacific, Station 263, depth 2650 fathoms.

## Subgenus 2. *Orothamnus*, Haeckel.

*Definition.*—Radial spines branched or arborescent.

8. *Orosphæra ramigera*, n. sp.

Radial spines cylindrical, spinulate, straight, about twice as long as the diameter of the spherical shell and as thick as its spinulate bars. Numerous simple spinulate branches, straight or slightly curved, and two to four times as long as the meshes, are irregularly scattered, and arise nearly perpendicularly from the bars.

*Dimensions.*—Diameter of the shell 2·0 to 2·2, length of the spines 4 to 5, breadth 0·05.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

9. *Orosphæra furcata*, n. sp.

Radial spines cylindrical, smooth, irregularly curved, about as long as the radius of the spherical shell and as thick as its smooth bars, forked at the distal end, with two or three terminal branches of various lengths. Meshes irregularly polygonal (the majority hexagonal).

*Dimensions.*—Diameter of the shell 1·2, length of the spines 0·7, breadth 0·03.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface (?).

10. *Orosphæra confluens*, n. sp.

Radial spines cylindrical, smooth, irregularly curved, two to three times as long as the diameter of the polyhedral shell, twice as broad as its smooth bars, bearing numerous irregular, lateral

branches, which are partly confluent and fenestrated (similarly as in Pl. 107, fig. 1), but not forming an outer lattice-shell. Meshes irregularly polygonal.

*Dimensions.*—Diameter of the shell 3·3, length of the spines 6 to 9, breadth 0·03.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

11. *Orosphæra arborescens*, n. sp. (Pl. 106, fig. 3).

*Orothamnus arborescens*, Haeckel, 1881, Atlas, *loc. cit.*

Radial spines cylindrical, rough, more or less curved, somewhat longer than the diameter of the subspherical or slightly ellipsoidal shell, and at the thicker base three times as broad as its smooth bars, bearing numerous irregularly branched and curved, sometimes confluent, lateral branches. Meshes irregularly quadrangular.

*Dimensions.*—Diameter of the shell 1·2 to 1·6, length of the spines 1·5 to 2·2, breadth 0·06.

*Habitat.*—South Atlantic, Station 335, depth 1425 fathoms.

## Genus 673. *Oroscena*,[1] n. gen.

*Definition.*—Orosphærida with a simple, polyhedral or subspherical lattice-shell, and with numerous pyramidal elevations on its surface, the top of which bears a radial spine.

The genus *Oroscena* differs from the preceding *Orosphæra* in the possession of numerous pyramidal or tent-shaped elevations, each of which bears on its top a radial spine. It exhibits therefore the same relation to the latter that *Sagoscena* does to *Sagosphæra* and *Auloscena* to *Aulosphæra*. The bases of the radial spines are usually connected by prominent concave crests, the edges of the pyramids. The species described of *Oroscena* seem to be very variable and transformistic.

### Subgenus 1. *Oroscenium*, Haeckel.

*Definition.*—Radial spines simple, smooth or spiny, but neither branched nor forked.

1. *Oroscena gegenbauri*, n. sp. (Pl. 106, fig. 4).

Radial spines club-shaped, about half as long as the radius of the shell, cylindrical and finely sulcate in the basal third, ovate and elegantly dimpled in the distal two-thirds. The bases of the radial spines are connected by prominent concave crests, which form the edges of the polyhedral shell. Meshes irregularly polygonal, the majority quadrangular, separated by denticulate bars.

[1] *Oroscena*=Shell with tent-shaped elevations; ὄρος, σκηνή.

*Dimensions.*—Diameter of the shell (without spines) 1·2 to 1·8, of the meshes 0·04 to 0·1; length of the spines 0·3 to 0·5.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

2. *Oroscena müllerí*, n. sp. (Pl. 107, fig. 8).[1]

Radial spines club-shaped, very similar to that of the preceding species, but much larger, about as long as the radius of the shell. Meshes irregularly polygonal, the majority pentagonal, separated by smooth bars.

*Dimensions.*—Diameter of the shell 2·0 to 2·4, length of the spines 1·0 to 1·2.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

3. *Oroscena cuvieri*, n. sp. (Pl. 107, fig. 6).

Radial spines club-shaped, compressed and smooth in the proximal half, spindle-shaped and dimpled in the distal half, about as long as the radius of the shell. Meshes irregularly polygonal, the majority hexagonal, separated by denticulate bars.

*Dimensions.*—Diameter of the shell 1·5, length of the spines 0·8.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

4. *Oroscena bærii*, n. sp. (Pl. 107, fig. 4).

Radial spines nearly spindle-shaped, undulate, tapering from the thicker middle towards both ends, coarsely dimpled, about one-third as long as the radius of the shell. Meshes irregularly polygonal, the majority pentagonal, separated by spinulate bars.

*Dimensions.*—Diameter of the shell 3·2, length of the spines 1·0 to 1·2, breadth 0·1.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

5. *Oroscena wolffii*, n. sp.

Radial spines cylindrical, spinulate, more or less curved, longer than the diameter of the shell and about twice as broad as its bars. Meshes irregularly polygonal, of very variable form and unequal size, separated by smooth bars.

*Dimensions.*—Diameter of the shell 2·5, length of the spines 3·0 to 3·5, breadth 0·02.

*Habitat.*—Indian Ocean, Zanzibar (Pullen), depth 2200 fathoms.

## Subgenus 2. *Orodendrum*, Haeckel.

*Definition.*—Radial spines branched or arborescent.

[1] In the plate the number is omitted by mistake. The figure is above in the middle.

6. *Oroscena huxleyi*, n. sp. (Pl. **12**, figs. 1, 1*a*).

Radial spines cylindrical, obliquely ascending and irregularly curved, about as long as the diameter of the shell and somewhat thicker than its thorny bars. A variable number of short, irregular, partly simple, partly forked, lateral branches arises from the spines. Meshes of the network very irregular, partly solid, partly hollow (fig. 1*a**), the majority quadrangular. This species, the first observed form of Orosphærida (captured the 21st February 1873 at Station 5), was at the beginning of my observations, in 1876, and when I had no knowledge of the central capsule, erroneously regarded by me as a gigantic Sphæroid (of the Monosphærida) and therefore placed in Pl. **12**. The long branched spines, afterwards observed complete in another specimen, were broken off in the specimen first figured.

*Dimensions.*—Diameter of the shell 2·0 to 2·5, length of the spines 2 to 3 mm., breadth 0·03.

*Habitat.*—North Atlantic (west of Canary Islands), Station 5, depth 2740 fathoms.

7. *Oroscena darwinii*, n. sp.

Radial spines cylindrical, irregularly curved and branched, about twice as long as the diameter of the shell; the branches are all again ramified and partly confluent (as in Pl. **107**, fig. 1). The branches and the bars of the network are of equal breadth, smooth (not thorny as in the similar preceding species). Meshes rather subregular, quadrangular.

*Dimensions.*—Diameter of the shell 2·4 to 2·8, length of the spines 4 to 5 mm., breadth 0·015.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

8. *Oroscena duncanii*, n. sp.

? *Hexactinellida dictyonina*, Martin Duncan, 1881, Journ. Roy. Micr. Soc., p. 175, pl. iii. figs. 4, 6.

Radial spines cylindrical, thorny, arborescent, somewhat shorter than the diameter of the shell, with irregular ramified branches (similar to *Orosphæra arborescens*, Pl. **106**, fig. 3). The size and ramification of the arborescent spinulate branches decrease towards the apex. The thicker branches are from two to three times as broad as the spinulate bars of the network. Meshes of the latter irregular, the majority quadrangular.

*Dimensions.*—Diameter of the shell 3·2, length of the spines 3·5 to 4·5, breadth 0·02 to 0·3.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms; coast of Portugal, 1095 fathoms.

## Genus 674. *Oroplegma*,[1] n. gen.

*Definition.*—Orosphærida with a spongy, spherical or slightly polyhedral lattice-shell, which is enveloped by a loose spongy framework and bears numerous radial spines.

The genus *Oroplegma* differs from the other Orosphærida in the development of an external lattice-work enveloping the internal primary shell, and produced by the union

[1] *Oroplegma*=Hilly shell of framework; ὄρος, πλέγμα.

of the branches of the radial spines. This outer shell is either a simple lattice-plate (comparable to the cortical shell of *Diplosphæra*), or a spongy framework (as in *Rhizoplegma*).

### Subgenus 1. *Oroplegmium*, Haeckel.

*Definition.*—External shell a simple fenestrated lamella, forming an outer concentric lattice-sphere around the inner primary shell.

#### 1. *Oroplegma diplosphaera*, n. sp. (Pl. 107, fig. 1).

Radial spines slender, cylindrical, smooth, more or less curved, about twice as broad as the smooth bars of the network. External shell a simple irregular lattice-sphere, with loose polygonal meshes, which are on an average three to four times as broad as the irregular meshes of the internal shell. The free prominent parts of the radial spines are irregularly branched, very long, with partly confluent branches.

*Dimensions.*—Diameter of the inner sphere 1·5 to 2·0, of the outer 2·5 to 3·0; length of the free spines 1·2, breadth 0·04.

*Habitat.*—Central Pacific, Station 265, depth 2900 fathoms.

#### 2. *Oroplegma spinulosum*, n. sp.

Radial spines slender, cylindrical, thorny, more or less curved, very similar to those of the preceding species; the shell also much resembles that of *Oroplegma perplexum*. It differs from the latter in the more regular fenestration of both shells, and mainly in the shape of the bars and the spine-branches, which are all spinulate and densely studded with small conical thorns.

*Dimensions.*—Diameter of the inner sphere 1·5 to 2·0, of the outer 2·5 to 3·0; length of the spines 1·2, breadth 0·03.

*Habitat.*—Central Pacific, Station 268, depth 2900 fathoms.

#### 3. *Oroplegma velatum*, n. sp.

Radial spines stout, cylindrical, somewhat club-shaped, spiny, slightly curved, about three to four times as broad as the thorny bars of the network. External shell a simple lattice-sphere with irregular polygonal meshes, which are for the most part pentagonal and about four times as broad as the polygonal meshes of the inner shell. The free prominent parts of the radial spines are thickened, club-shaped, and about as long as the radius.

*Dimensions.*—Diameter of the inner sphere 2·0 to 2·4, of the outer 2·8 to 3·6; length of the free spines 0·5 to 0·7, breadth 0·12 to 0·15.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

### Subgenus 2. *Orodictyum*, Haeckel.

*Definition.*—External shell a complex framework, forming an outer spongy envelope around the inner primary shell.

#### 4. *Oroplegma spongiosum*, n. sp. (Pl. 107, fig. 3).

Radial spines stout, cylindrical, spinulate, slightly curved, three to five times as broad as the inner rough bars. External shell with pyramidal elevations, forming a loose spongy framework, the irregular polygonal meshes of which are two to five times as broad as those of the enclosed internal shell; the thickness of the spongy envelope equals about half the radius of the inner shell. External free prolongations of the radial spines about equal to the radius.

*Dimensions.*—Diameter of the inner sphere 2 to 2·5, of the outer 3 to 3·5; length of the free radial spines 0·5 to 2·0, breadth 0·1.

*Habitat.*—North Pacific, Station 241, depth 2300 fathoms.

#### 5. *Oroplegma giganteum*, n. sp. (Pl. 107, fig. 2).

Radial spines slender, cylindrical, spinulate, irregularly curved, about twice as broad as the spinulate tubular bars of the network (fig. 2). External shell an irregular, loose, spongy framework, the polygonal meshes of which are three to six times as broad as the rounded irregular meshes of the inner shell; the thickness of the spongy envelope about equals the radius of the inner shell. External free prolongation of the radial spines irregularly branched.

*Dimensions.*—Diameter of the inner sphere 3·2 to 3·5, of the outer 5·4 to 6·6; length of the free spines 1·4 to 1·5, breadth 0·03.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

### Family LXXV. Sagosphærida, n. fam. (Pl. 108).

*Definition.*—Phæodaria with a large spherical (or sometimes polyhedral), very delicate shell, which is composed of solid, very thin and long threads. Nodal points of the arachnoidal network without astral septa. Meshes large, triangular. Surface of the shell usually armed with radial spines and often studded with pyramidal elevations. No peculiar mouth in the shell. Central capsule tripylean, in the centre of the shell.

The family Sagosphærida comprises a rather large number of common and widely distributed Phæodaria, which in respect of the special form and differentiation of the shell exhibit the greatest similarity to the common Aulosphærida, but differ essentially from them in the peculiar structure of the network. This is not composed of stout hollow cylindrical tubes, but of solid, very thin threads; and these fine arachnoidal

threads are simply united or confluent at the nodal points, and are not connected by a radial or stellate septal junction, as in the Aulosphærida. There are, therefore, neither astral septa nor a nodal cavity in each nodal point. The delicate shape of the thin and fragile threads separates the Sagosphærida from the closely allied Orosphærida, the thick bars of which contain a central axial canal and exhibit a concentric structure. Another difference between these two similar families is indicated by the form of the meshes of the network, which are constantly triangular in the Sagosphærida, but irregularly polygonal or quadrangular in the Orosphærida. The general habit of these two families, however, is very different, since the big and stout spheres of the Orosphærida are the coarsest and rudest spherical shells of all Radiolaria, whilst the fragile and delicate spheres of the Sagosphærida represent the finest and most tender in the whole class.

The spherical lattice-shell of the Sagosphærida has a considerable size, its diameter being usually between one and three millimetres, rarely less or more. Some species are very common and widely distributed, usually accompanying the common Aulosphærida; very frequently the similar shells of the two are found interwoven. But in spite of this frequency and visible size, the Sagosphærida have hitherto almost completely escaped the attention of observers. The main cause of this strange fact may be their extreme delicacy and fragibility, so that complete and intact shells occur very rarely, the majority being more or less broken and incomplete. It seems that only two species of Sagosphærida have been hitherto observed.

The first form described is *Sagmarium trigonizon*, observed by me in 1859 living at Messina, and figured in 1862 in my Monograph as *Dictyosoma trigonizon* (Taf. xxvi. figs. 4–6), but afterwards called *Spongodictyum trigonizon* (*loc. cit.*, p. 459). I supposed at that time (now twenty-five years ago), that this remarkable and in many respects distinct form might belong to the Spongosphærida, and that an internal, triple, spherical lattice-shell, found entangled in its spongy framework, might be its central "medullary shell." But at present, having found many shells of different Radiolaria accidentally entangled in the arachnoidal framework of various Sagosphærida, I think it much more probable, that that "triple medullary shell," composed of three simple concentric lattice-spheres, was really a species of *Plegmosphæra* or *Actinomma*, accidentally entangled in the arachnoidal spongy framework of *Sagmarium*. This is the more probable, as I had observed very frequently at Messina, in 1859, fragments of that framework, but only once the triple lattice-shell which I supposed to be the "triple medullary shell" of the former. The peculiar structure of the loose framework, its very large triangular meshes and thin arachnoidal bars, partly provided with cruciate verticils (*loc. cit.*, Taf. xxvi. figs. 4, 5) have been very frequently observed by me during the last ten years in various Sagosphærida (PHÆODARIA), but never in any true Sphæroidea (SPUMELLARIA).

The second species of Sagosphærida hitherto observed, is *Sagoscena gracilis*, described and figured in 1879 by Richard Hertwig as *Aulosphæra gracilis* (Organism.

d. Radiol., p. 91, Taf. ix. fig. 4). He too observed only fragments of destroyed and incomplete shells, and was led by their striking similarity to fragments of *Aulosphæra elegantissima* to unite it with the genus *Aulosphæra*. But the accurate description and the figure given by him of the fragments observed leaves no doubt that it was a true *Sagoscena*.

In the collection of the Challenger the Sagosphærida are so common and so richly represented, that we may describe here not less than seven genera and thirty-three species, but this may be a small part only of the numerous species of this family, which seems to be widely distributed over all oceans, in the Arctic and Antarctic as well as in temperate and tropical zones. The majority are inhabitants of the surface, but a few species have been found only in deep-sea soundings. A striking fact is their usual association with the similar Aulosphærida. The majority of shells of both families were found entangled in one another.

The shell of all Sagosphærida seems to be spherical or nearly spherical in the complete state; but complete spheres can be observed only very rarely, and it is not impossible that deviations from the spherical form exist just as in some Aulosphærida (*e.g.*, the lenticular *Aulophacus* and the spindle-shaped *Aulatractus*). The diameter of the spheres usually seems to be between 1 and 2, often also 3 millimetres; very rarely shells occur which are less than 1 or more than 3 (4 or 5) millimetres.

The siliceous network or lattice-work of the Sagosphærida exhibits a very characteristic shape, and this enables one to distinguish it at first sight from all the other Radiolaria. It is constantly composed of triangular, very large meshes, which are separated by very thin and delicate, flexible and elastic bars. With respect to the arrangement of these meshes we distinguish two different subfamilies; in the Sagenida the wall of the spherical shell is very thin and composed only of a simple lattice-plate; in the Sagmarida the wall is thickened and spongy, with a complete wicker-work of threads, interwoven in different directions.

The typical triangular form of the large meshes is usually regular or subregular in the fenestrated Sagenida, more or less irregular in the spongy Sagmarida. In many cases, however, irregular triangles also occur in the former, and regular triangles in the latter subfamily. Very rarely irregular polygonal meshes are found in a part of the network, small connecting bars being developed accidentally between two neighbouring sides of the triangles. The diameter of the meshes is usually between 0·1 and 0·2 mm., often also greater, between 0·2 and 0·3, rarely smaller, 0·05 to 0·09 mm. The triangular meshes of the Sagosphærida are therefore on an average ten times as large as the usual meshes in the network of the common S p h æ r o i d e a.

The filiform bars, or the thread-shaped, very long and thin rods between the triangular meshes, are scarcely less characteristic of the Sagosphærida than the form and size of the meshes. Their length is usually between 0·1 and 0·2 mm., often also

from 0·2 to 0·3 mm., whilst their thickness is only 0·002 to 0·004 mm., often it is less than 0·001, rarely more than 0·005 mm. The nodal points of the network, in which six threads are usually united, are more or less thickened, often stellate (Pl. 108, figs. 9, 12, &c.). Sometimes they are pierced by a central pore. The thin threads are constantly cylindrical, never edged or prismatic, very elastic and flexible; usually they are perfectly smooth, rarely spiny or thorny, sometimes provided with scattered cruciate verticils of lateral branches, as in *Sagena crucifera* and in the first described form of this family, *Sagmarium trigonizon* (compare my Monograph, 1862, Taf. xxvi. fig. 5).

The surface of the spherical shell is smooth only in two genera of Sagosphærida, in *Sagena* and *Sagmarium* (Pl. 108, figs. 2, 8). In the five other genera it is covered either with radial spines, arising from the nodal points of the network, or with peculiar cortical pyramids or tent-shaped elevations (Pl. 108, figs. 1, 3–6, &c.). These pyramids are of the same characteristic shape as in the similar *Auloscena* among the Aulosphærida (Pl. 110, fig. 1); usually, however, they are less regular than in the latter. The pyramids or tents are usually six-sided, often, however, they are also four-sided or three-sided, more rarely five, seven or more sided. The edges of the pyramids are formed by filiform bars similar to those which compose the original lattice-work of the Sagosphærida. The cavity of the pyramids is quite simple in *Sagoscena* (figs. 1, 5, 6), whilst in *Sagenoscena* and *Sagoplegma* a radial column arises in its axis, the thickened axial rod (figs. 3, 4, 10).

The radial spines, which arise either from the tops of the pyramids or from the nodal points of the network, exhibit in the Sagosphærida a variety and elegance similar to the closely allied Aulosphærida. Sometimes a single radial spine arises in each nodal point or at the top of each pyramid (figs. 3, 4, 10); at other times two, three, or four (rarely more) divergent spines (figs. 6–9, 12, 13). These are rarely quite simple, usually provided with lateral and terminal branches. The lateral branches are either scattered irregularly, or regularly disposed in elegant verticils, each of which is usually composed of three or four short branches (Pl. 108, figs. 9, 13). The terminal branches form either a similar verticil, or a bunch or corona, composed of numerous radial secondary spines. The distal ends of the terminal as well as of the lateral branches are rarely simple, usually they are provided with a spinulate knob or with an elegant spathilla (Pl. 108, figs. 3, 9, 13).

The *central capsule* of the Sagosphærida is comparatively small, as it also is in the Aulosphærida and Orosphærida. Its diameter is usually about one-third or one-fourth that of the enveloping shell, between 0·2 and 0·3, often only 0·12 to 0·18, rarely more than 0·3 mm. It is surrounded on the oral half by a red or dark phæodium and separated from the inner surface of the shell by the voluminous calymma. The subspherical nucleus is usually about half as broad as the capsule. The three openings of the latter, the large tubular astropyle and the two opposite lateral parapylæ, exhibit the same shape

as in the closely allied Aulosphærida (Pl. 111, fig. 3). The pseudopodia arising from the central capsule form a loose network in the calymma, and proceed over its surface as numerous delicate radial filaments, often supported by the radial spines.

*Synopsis of the Genera of Sagosphærida.*

| | | | |
|---|---|---|---|
| I. Subfamily Sagenida. Wall of the spherical shell composed of a simple lattice-plate, with or without pyramidal elevations. | Surface of the spherical shell smooth or spiny, without pyramidal elevations. | No radial spines, surface smooth, | 675. *Sagena.* |
| | | Radial spines in the nodal points, | 676. *Sagosphæra.* |
| | Surface of the spherical shell covered with pyramidal or tent-shaped elevations. | Pyramids without internal axial rod, | 677. *Sagoscena.* |
| | | Pyramids with an internal radial axial rod, | 678. *Sagenoscena.* |
| II. Subfamily Sagmarida. Wall of the spherical shell spongy, composed of an irregular complicated wicker-work. | Surface of the spherical shell smooth or spiny, without pyramidal elevations. | Surface smooth, without radial spines, | 679. *Sagmarium.* |
| | | Surface studded with radial spines, | 680. *Sagmidium.* |
| | Surface of the spherical shell covered with pyramidal elevations. | Pyramids on the top with a radial spine or a bunch of divergent spines, | 681. *Sagoplegma.* |

## Subfamily 1. Sagenida, Haeckel.

*Definition.*—Sagosphærida with a delicate spherical shell, the thin wall of which is composed of a simple lattice-plate, not spongy.

### Genus 675. *Sagena*,[1] n. gen.

*Definition.*—Sagosphærida with a delicate spherical shell, the thin wall of which is composed of a simple smooth lattice-plate, without radial spines.

The genus *Sagena* is the simplest of the Sagosphærida and may be regarded as the common ancestral form of this family. The delicate wall of the simple spherical lattice-shell is composed of large, regular, or subregular, triangular meshes, the nodal points of which bear no radial spines. It agrees therefore perfectly with *Aularia*, and differs from this simplest form of Aulosphærida only in the structure of the skeleton, which is composed not of hollow articulated tubes, but of very thin solid threads. The skeleton may therefore also be confounded with *Cenosphæra*, but the central capsule of this latter is "peripylean," with numerous fine pores in the entire wall, whilst that of *Sagena* is "tripylean," having the proboscis of all Phæodaria.

[1] *Sagena*=Drag-net; σαγήνη.

1. *Sagena ternaria*, n. sp. (Pl. 108, fig. 8).

Network subregular, with equilateral triangular meshes, intermingled with single irregular meshes (fig. 8). Bars of the network smooth, its nodal points solid, not pierced.

*Dimensions.*—Diameter of the spherical shell 1·5 to 2·5, length of the bars 0·1 to 0·2, breadth 0·002 to 0·005.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, surface.

2. *Sagena pertusa*, n. sp.

Network subregular, with nearly equal triangular meshes. Bars of the network smooth, its nodal points pierced by a circular hole.

*Dimensions.*—Diameter of the shell 1·2 to 1·8, length of the bars 0·2 to 0·25, breadth 0·003.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

3. *Sagena triangula*, n. sp.

Network very regular, with equilateral triangular meshes. Bars of the network spinulate, like those of *Sagoplegma spinulosa* (Pl. 108, fig. 14), its nodal points solid, not pierced.

*Dimensions.*—Diameter of the shell 2·2, length of the bars 0·25, breadth 0·004.

*Habitat.*—South Atlantic, Station 325, surface.

4. *Sagena crucifera*, n. sp.

Network more or less irregular, with unequal triangular meshes. Bars of the network studded with scattered, rectangular, minute crosses, arising perpendicularly, each cross composed of four small equal bars. Nodal points partly solid, partly pierced by a hole. Network very similar to that of *Dictyosoma trigonizon*, figured in my Monograph, Taf. xxvi. figs. 4, 5.

*Dimensions.*—Diameter of the shell 1·5, length of the bars 0·1 to 0·2, breadth 0·003.

*Habitat.*—Mediterranean, Atlantic, Canary Islands, Station 353, surface.

## Genus 676. *Sagosphæra*,[1] n. gen.

*Definition.*—Sagosphærida with a delicate spherical shell, the thin wall of which is composed of a simple lattice-plate, and bears on its nodal points radial spines.

The genus *Sagosphæra* differs from the preceding *Sagena*, its ancestral form, in the development of radial spines on the nodal points of the simple delicate lattice-sphere. It exhibits therefore the same relation to the latter as *Aulosphæra* bears to *Aularia*.

[1] *Sagosphæra* = Spherical armour; σάγη, σφαῖρα.

The regular or subregular triangular meshes of the lattice-sphere are separated in *Sagosphæra* by solid, very thin threads, in the similar *Aulosphæra*, however, by thicker hollow tubes. The genus *Sagosphæra* may be divided into two subgenera:—*Sagosphærella* with a single radial spine at each nodal point of the network, and *Sagosphæroma* with a bunch of two to four or more divergent radial spines.

1. *Sagosphæra trigonilla*, n. sp.

Radial spines simple, straight, smooth, about as long as the smooth bars of the network, a single one at each nodal point. Meshes very regular, of equal size, equilateral triangular. (Similar to the common *Aulosphæra trigonopa*.)

*Dimensions.*—Diameter of the sphere 1·2 to 1·8, length of the bars 0·1 to 0·2, breadth 0·002 to 0·006.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Pacific, surface.

2. *Sagosphæra penicilla*, n. sp. (Pl. 108, fig. 10).

Radial spines straight, stout, a single one at each nodal point, twice as thick, but of the same length as the smooth bars of the network, armed at the distal end with a brush of numerous thin radial bristles. (Very similar to *Sagenoscena pencillata*, but without pyramidal elevations on the surface of the sphere.)

*Dimensions.*—Diameter of the sphere 1·0 to 1·5, length of the bars 0·1 to 0·15, breadth 0·002 to 0·004.

*Habitat.*—Antarctic Ocean, Station 154, surface.

3. *Sagosphæra verticilla*, n. sp.

Radial spines slender, slightly curved, a single one at each nodal point, armed with three to five cruciate verticils, each of which is composed of four crossed lateral branches with spinulate terminal knobs (similar to *Sagmidium crucicorne*, Pl. 108, fig. 9), but with a spherical shell, having a simply latticed, and not a spongy wall.

*Dimensions.*—Diameter of the sphere 2·0 to 2·5, length of the bars 0·1 to 0·2, breadth 0·002.

*Habitat.*—North Pacific, Station 256, surface.

4. *Sagosphæra furcilla*, n. sp. (Pl. 108, figs. 11, 11*a*).

Radial spines short, spinulate, with a spiny terminal knob (fig. 11*a*), two or three arising from each nodal point of the network in divergent directions, only one-third or one-fourth as long as its smooth bars. Meshes more or less irregular, triangular.

*Dimensions.*—Diameter of the sphere 2·2, length of the bars 0·2 to 0·3, breadth 0·004.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

5. *Sagosphæra coronilla*, n. sp.

Radial spines slender, smooth, three to six arising from each nodal point of the network in divergent directions, about as long as its smooth bars, crowned at the distal end with a bunch of twenty to thirty radial terminal branches, and provided with a spinulate knob at the distal end (similar to *Sagenoscena stellata*, Pl. 108, fig. 3).

*Dimensions.*—Diameter of the sphere 3·0, length of the bars 0·1 to 0·2, breadth 0·002.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 677. *Sagoscena*,[1] n. gen.

*Definition.*—Sagosphærida with a delicate spherical shell; the thin wall of which is composed of a simple lattice-plate and covered with numerous pyramidal elevations; each pyramid bears on its top one or more radial spines, but has no axial rod in its radial axis.

The genus *Sagoscena*, and the following closely allied *Sagenoscena* (both very common and widely distributed), exhibit a peculiar and very remarkable structure of the delicate lattice-shell, similar to that which *Auloscena* represents among the Aulosphærida. The surface of the simple spherical lattice-shell is covered with numerous pyramidal or tent-shaped elevations. These elegant and delicate pyramids are, however, in *Sagoscena* usually not so regular as in the similar *Auloscena*; the edges of the pyramids are in the latter hollow cylindrical tubes, in the former thin solid threads. The top of each pyramid usually bears a bunch of apical spines.

1. *Sagoscena castra*, n. sp. (Pl. 108, fig. 1).

Pyramids subregular, of equal size and similar form, usually three-sided, crowned at the top with three divergent apical spines, which alternate with the three edges of the pyramids and bear a small spinulate terminal knob. (Some four-sided and single five-sided pyramids are often intermingled with the three-sided.)

*Dimensions.*—Diameter of the sphere 1·7 to 2·3, length of the bars 0·2 to 0·25, breadth 0·008.

*Habitat.*—South-Eastern Pacific, Stations 295, 296, surface.

2. *Sagoscena tentorium*, n. sp. (Pl. 108, fig. 6).

Pyramids subregular, of equal size and similar form, usually four-sided, crowned at the top with three divergent apical spines, which are trifurcate at the distal end. (Some three-sided and five-sided pyramids are often intermingled with the four-sided.)

*Dimensions.*—Diameter of the sphere 2·2, length of the bars 0·2 to 0·25, breadth 0·005.

*Habitat.*—South Pacific, Station 291, surface.

[1] *Sagoscena*=Armour with tents; σάγη, σκηνή.

3. *Sagoscena prætorium*, n. sp. (Pl. 108, fig. 7).

Pyramids subregular, of equal size and similar form, usually four-sided, crowned at the distal top with three or four divergent apical spines, which bear some irregular verticils of lateral and terminal branches. (Some five-sided and some six-sided pyramids are often intermingled with the four-sided.)

*Dimensions.*—Diameter of the sphere 2·6, length of the bars 0·3, breadth 0·006.

*Habitat.*—Central Pacific, Stations 271 to 274, surface.

4. *Sagoscena pellorium*, n. sp. (Pl. 108, fig. 5).

Pyramids subregular, of equal size and similar form, usually five-sided or six-sided, crowned at the distal end with three to six divergent apical spines, which bear an irregularly spinulate terminal knob. (The size and form of the apical spines is here very variable, as well as the number of the edges of the pyramids, which varies between three and six.)

*Dimensions.*—Diameter of the sphere 3·2, length of the bars 0·15 to 0·25, breadth 0·008.

*Habitat.*—Antarctic Ocean, Station 156, surface.

5. *Sagoscena cruciarium*, n. sp.

Pyramids subregular, usually six-sided (intermingled with single five-sided and seven-sided or eight-sided forms), crowned at the distal top with three divergent, slender, apical spines, each of which bears three to six regular cruciate verticils; the four crossed lateral branches of each verticil bearing a spinulate terminal knob. (Similar to *Sagoplegma scenophora*, Pl. 108, fig. 13.)

*Dimensions.*—Diameter of the shell 2·5, length of the bars 0·2 to 0·3, breadth 0·004.

*Habitat.*—North Pacific, Stations 240 to 244, surface.

6. *Sagoscena debilis*, n. sp.

Pyramids more or less irregular, with four, five, or six sides, of somewhat different form and unequal size; crowned at the top with one, two, or three slender apical spines, of variable length. These spines as well as the bars of the network bear scattered cruciate verticils, each usually composed of four crossed, small, lateral branches.

*Dimensions.*—Diameter of the shell 2 to 3·0, length of the bars 0·1 to 0·15, breadth 0·003.

*Habitat.*—Central Pacific, Stations 263 to 274, surface.

7. *Sagoscena gracilis*, Haeckel.

*Aulosphæra gracilis*, R. Hertwig, 1879, Organism. d. Radiol., p. 91, Taf. ix. fig. 4.

Pyramids more or less irregular, with five, six, or seven sides, often of somewhat different form and unequal size; crowned at the top with a single radial spine, which has the same size as the

bars of the network, and bears in its distal half four cruciate verticils, each composed of four crossed and curved horizontal branches.

*Dimensions.*—Diameter of the sphere 1 to 2, length of the bars 0·08 to 0·09, breadth 0·002.

*Habitat.*—Mediterranean (Messina), surface.

8. *Sagoscena fragilis*, n. sp.

Pyramids very irregular, with four to eight sides, of different form and unequal size; crowned at the top with a single, slender, radial spine, of the same thickness as the slender bars of the network; the latter as well as the former are smooth, without lateral branches.

*Dimensions.*—Diameter of the sphere 1·0 to 2·0, length of the bars 0·1 to 0·2, breadth 0·001 to 0·002.

*Habitat.*—Cosmopolitan; Atlantic, Pacific, surface.

## Genus 678. *Sagenoscena*,[1] n. gen.

*Definition.*—Sagosphærida with a delicate spherical shell, the thin wall of which is composed of a simple lattice-plate and covered with numerous pyramidal elevations; each pyramid bears on its top one or more radial spines, and has an internal axial rod in its radial axis.

The genus *Sagenoscena* differs from the preceding closely allied *Sagoscena* in the possession of an internal radial axial rod, which arises in the centre of the base of each pyramid, and is prolonged usually over its apex into a free, radial, apical spine. The distal end of the latter is usually armed with a bunch of terminal teeth or bristles. In the similar *Sagoscena* the internal cavity of the pyramids is simple, without axial rod.

1. *Sagenoscena stellata*, n. sp. (Pl. 108, fig. 3).

Pyramids rather regular, usually six-sided (intermingled with single five-sided and four-sided forms); their axial rod and its prolongation, the radial apical spine, three to four times as thick as the slender edges of the pyramid. The distal end of the apical spine bears an elegant star of numerous radially divergent terminal branches, each of which is armed with a spinulate terminal knob.

*Dimensions.*—Diameter of the sphere 3·5 to 4·0, length of the net bars 0·3, breadth 0·003; length of the radial spines 0·2, breadth 0·012.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

2. *Sagenoscena ornata*, n. sp. (Pl. 108, fig. 4).

Pyramids rather regular, usually six-sided (intermingled with single five-sided and seven-sided forms); their axial rod and apical spine spindle-shaped, two to four times as thick as the smooth bars

[1] *Sagenoscena*=Net with tents; σαγήνη, σκηνή.

of the network. The distal end of the radial spines bears an elegant, foliate, terminal knob, composed of four to six vertical pinnate leaves, lying in crossed meridional planes.

*Dimensions.*—Diameter of the sphere 2 to 3, length of the rods 0·1 to 0·2, breadth 0·003 to 0·01.

*Habitat.*—Antarctic Ocean, Station 156, depth 1975 fathoms.

3. *Sagenoscena penicillata*, n. sp. (Pl. 108, fig. 10).

Pyramids rather regular, usually six-sided (intermingled with single five-sided, seven-sided, and eight-sided forms); their axial rod and apical spine spindle-shaped, thicker than the smooth bars of the network. The distal end of the radial spines is penicillate and bears a brush of bristle-shaped, radial, terminal spinules (compare *Sagosphæra penicilla*, p. 1607).

*Dimensions.*—Diameter of the sphere 1 to 1·5, length of the bars 0·1 to 0·15, breadth 0·004 to 0·005.

*Habitat.*—Antarctic Ocean, Station 157, depth 1950 fathoms.

4. *Sagenoscena coronata*, n. sp.

Pyramids rather regular, usually four-sided (intermingled with single five-sided and six-sided forms); their axial rod and apical spines cylindrical, scarcely thicker than the smooth bars of the network. The distal end of the radial spines bears a corona of twenty to thirty curved terminal branches, which form a regular circle, and are armed with a spinulate terminal knob.

*Dimensions.*—Diameter of the sphere 2 to 3, length of the bars 0·12 to 0·18, breadth 0·004 to 0·008.

*Habitat.*—North Pacific, Station 256, surface.

5. *Sagenoscena spathillata*, n. sp.

Pyramids more or less irregular, of different sizes and various forms, each composed of four to eight convergent rods and a central axial rod. The latter is prolonged into a free apical spine, which bears at the distal end a spathilla of eight to twelve recurved teeth, and often beyond it a second similar verticil.

*Dimensions.*—Diameter of the sphere 4·0, length of the bars 0·1 to 0·2, breadth 0·002.

*Habitat.*—Arctic Ocean, Greenland (Olrik).

6. *Sagenoscena cruciata*, n. sp.

Pyramids very irregular, of different sizes and various forms, each composed of six to nine convergent rods and a central axial rod. The latter is prolonged into a free apical spine, which bears three to five cruciate verticils, each composed of four perpendicularly crossed lateral branches which bear at the distal end a spinulate knob (similar to *Sagmidium crucicorne*, Pl. 108, fig. 9).

*Dimensions.*—Diameter of the sphere 1·0 to 1·2, length of the bars 0·06 to 0·09, breadth 0·001.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

## Subfamily 2. SAGMARIDA, Haeckel.

*Definition.*—Sagosphærida with a spongy spherical shell, the thickened wall of which is composed of a loose spongy framework.

### Genus 679. *Sagmarium*, n. gen.

*Definition.*—Sagosphærida with a spongy spherical shell, the thickened wall of which is composed of a loose spongy framework, and exhibits a smooth surface, without radial spines and pyramidal elevations.

The genus *Sagmarium*, and the following two genera of Sagosphærida, represent together the subfamily Sagmarida, differing from the preceding Sagenida in the spongy structure of the shell-wall. Whilst in the latter the thin wall of the delicate spherical shell is composed of a simple lattice-plate with triangular meshes, in the former numerous branches diverge from the nodal points of these meshes, and produce by union an irregular and loose spongy framework. The surface of this spongy hollow sphere (similar to *Plegmosphæra*) is in *Sagmarium* smooth.

1. *Sagmarium spongodictyum*, n. sp. (Pl. 108, fig. 2).

Spongy wall of the hollow sphere about half as thick as the radius of its cavity. Bars of the spongy framework very thin and fragile, smooth, without thorns.

*Dimensions.*—Diameter of the sphere 2·0 to 2·4; length of the bars 0·1 to 0·2, breadth 0·001.

*Habitat.*—South Atlantic, Station 333, surface.

2. *Sagmarium plegmosphœrium*, n. sp. (Pl. 108, fig. 14).

Spongy wall of the hollow sphere about one-fourth as thick as the radius of its cavity. Bars of the spongy framework rather stout, studded with numerous small spines, which arise perpendicularly from their surface.

*Dimensions.*—Diameter of the sphere 1·2 to 1·5, length of the bars 0·1 to 0·16, breadth 0·004.

*Habitat.*—Tropical Atlantic, Station 347, surface.

3. *Sagmarium trigonizon*, Haeckel.

*Dictyosoma trigonizon*, Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 841.
*Spongodictyon trigonizon*, Haeckel, 1862, Monogr. d. Radiol., p. 459, Taf. xxvi. figs. 4, 5.

Bars of the spongy framework thin, irregularly curved, bearing scattered small crosses, which are composed of four small rods arising perpendicularly from the bars. Nodal points of the frame-

[1] *Sagmarium* = Covering of a shield, armour; σαγμάριον.

work partly pierced by a hole. The peculiar network of a complete specimen, observed by me at Portofino in 1880, was so similar to that of *Spongodictyon trigonizon*, described above (p. 91), and figured in 1862 in my Monograph, that I am doubtful if the two forms are not identical, the two medullary shells of the latter being accidentally entangled in the framework. (Compare p. 1602.)

*Dimensions.*—Diameter of the sphere 1·1 to 1·5, length of the bars 0·1 to 0·2, breadth 0·002.

*Habitat.*—Mediterranean (Messina, Portofino), surface.

## Genus 680. *Sagmidium*,[1] n. gen.

*Definition.*—Sagosphærida with a spongy spherical shell, the thickened wall of which is composed of a loose spongy framework, and bears on the nodal points of its surface radial spines.

The genus *Sagmidium* differs from the preceding *Sagmarium* in the development of radial spines on the surface of the spongy hollow sphere. It bears therefore the same relation to the latter as *Sagosphæra* does to *Sagena*, and may be derived either from *Sagmarium* by the formation of radial spines, or from *Sagosphæra* by development of the spongy envelope.

### 1. *Sagmidium unicorne*, n. sp.

Radial spines simple, straight, smooth, a single one at each nodal point of the surface of the spongy sphere, bearing on its distal end a spinulate knob, or a bunch of numerous radial bristles. (Similar to *Sagenoscena penicillata*, Pl. 108, fig. 10.) Bars of the spongy framework smooth.

*Dimensions.*—Diameter of the sphere 3·0 to 3·5, length of the bars 0·15 to 0·2, breadth 0·003 to 0·006.

*Habitat.*—Antarctic Ocean, Station 256, surface.

### 2. *Sagmidium tricorne*, n. sp.

Radial spines simple, smooth, usually three divergent united at each nodal point of the surface (sometimes two or four instead of three). Each spine bears on its distal end three short divergent conical teeth. (Similar to the terminal teeth of *Sagoscena tentorium*, Pl. 108, fig. 6.) Bars of the spongy framework smooth.

*Dimensions.*—Diameter of the sphere 1·6 to 2·4, length of the bars 0·06 to 0·09, breadth 0·001 to 0·002.

*Habitat.*—Central Pacific, Stations 263 to 268, surface.

### 3. *Sagmidium crucicorne*, n. sp. (Pl. 108, fig. 9).

Radial spines slender, verticillate, three or four divergent arising from each nodal point of the surface. Each spine bears three to six cruciate verticils of lateral branches; each verticil being

[1] *Sagmidium*=Small armour, military cloak; σαγμίδιον.

composed of four crossed small branches with a spinulate terminal knob. Bars of the spongy framework partly covered with similar verticils.

*Dimensions.*—Diameter of the sphere 2·0 to 3·0, length of the bars 0·2 to 0·3, breadth 0·002 to 0·003.

*Habitat.*—North Pacific, Stations 240 to 244, surface.

4. *Sagmidium quadricorne*, n. sp. (Pl. 108, fig. 12).

Radial spines stout, smooth, cylindrical, usually four divergent arising from each nodal point of the surface (sometimes three, five, or six, instead of four). Each spine bears on its distal end a club-shaped stellate knob. Bars of the spongy framework smooth.

*Dimensions.*—Diameter of the sphere 4·5, length of the bars 0·2 to 0·3, breadth 0·003 to 0·005.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

5. *Sagmidium multicorne*, n. sp.

Radial spines slender, more or less curved, verticillate, in variable number (three to six) divergent, arising from the nodal points of the surface. The spines as well as the bars of the spongy framework are partly simple, partly covered with irregularly scattered cruciate verticils, very similar to those of *Sagmarium trigonizon* (or *Dictyosoma trigonizon*), figured in my Monograph, pl. xxvi. figs. 4, 5.

*Dimensions.*—Diameter of the sphere 5·0, length of the bars 0·2 to 0·3, breadth 0·003.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

## Genus 681. *Sagoplegma*,[1] n. gen.

*Definition.*—Sagosphærida with a spongy spherical shell, the thickened wall of which is composed of a loose spongy framework, and bears on its surface numerous pyramidal elevations.

The genus *Sagoplegma* differs from *Sagmarium*, its ancestral form, in the development of pyramidal or tent-shaped elevations on the surface of the spongy hollow sphere. It exhibits, therefore, the same relation to the latter as the similar *Sagoscena* bears to *Sagena*. The wall of the spherical shell is in the two latter genera a thin simple lattice-plate, in the former a thickened spongy framework.

1. *Sagoplegma pyramidophora*, n. sp.

Pyramids on the surface of the spongy sphere subregular, mostly tetrahedral, of nearly equal size and similar form. The three edges of each pyramid are prolonged over its top into three

[1] *Sagoplegma* = Armour of framework ; σάγη, πλέγμα.

short, divergent, apical spines which are forked at the distal end. (Very similar to *Sagoscena castra* and *Sagoscena tentorium*, Pl. 108, figs. 1, 6, probably derived from them, but differing in the spongy structure of the thickened shell-wall, which is half as thick as the radius of its cavity.)

*Dimensions.*—Diameter of the sphere 2·0 to 2·5, length of the bars 0·15 to 0·2, breadth 0·002.

*Habitat.*—North Pacific, Stations 231 to 239, surface.

2. *Sagoplegma scenophora* (Pl. 108, fig. 13).

Pyramids on the surface of the spongy sphere irregular, with three to six sides, unequal in size and different in form. The edges of each pyramid are prolonged over its top into three to six divergent apical spines, which bear three to six cruciate verticils, each composed of four small, crossed, lateral branches, armed with a spinulate knob at the distal end.

*Dimensions.*—Diameter of the sphere 3·0 to 3·5, length of the bars 0·25 to 0·35, breadth 0·003.

*Habitat.*—North Pacific, Stations 252, 253, surface.

## Family LXXVI. AULOSPHÆRIDA, Haeckel (Pls. 109–111).

*Aulosphærida*, Haeckel, 1862, Monogr. d. Radiol., p. 357.

*Definition.*—PHÆODARIA with a large spherical or subspherical (rarely spindle-shaped) articulated shell, which is composed of hollow tangential tubes. Nodal points of the loose network stellate, with a nodal cavity and astral septa. Meshes either triangular or polygonal. Hollow radial spines arise usually at the nodal points of the surface. No peculiar mouth in the shell. Central capsule tripylean, placed in the centre of the shell.

The family Aulosphærida comprises a great number of splendid and widely distributed PHÆODARIA, which have a special interest on account of the peculiarly complicated structure of their large lattice-shell, of the extraordinary beauty of their form and of their remarkable relations to the other PHÆODARIA. They differ from all the other Radiolaria in the peculiar articulate composition of the spherical skeleton of hollow tangential tubes, which are connected (and at the same time separated) by sutural or astral septa and filled up by jelly. The same peculiar structure recurs only in the closely allied Cannosphærida, which, however, differ in the possession of a second internal concentric shell, connected with the outer by radial beams. The similar Sagosphærida, which exhibit corresponding forms in various genera, differ from the Aulosphærida in the simpler structure of the delicate lattice-sphere, which is composed of very thin solid threads of silica, without astral septa. The Orosphærida, finally, also nearly related to the preceding families, differ from them in the coarse structure of the lattice-sphere, which is composed of very thick tangential, concentrically stratified rods, with an internal axial canal, but without astral septa at the nodal points.

One genus only, and two species, of Aulosphærida have been hitherto known, having been discovered by me in 1859 at Messina, and described in my Monograph in 1862 as *Aulosphæra trigonopa* and *Aulosphæra elegantissima* (*loc. cit.*, p. 357, Taf. x. figs. 4, 5; Taf. xi. figs. 5, 6). The characteristic structure of their central capsule, as true TRIPYLEA, was afterwards, in 1879, described more accurately by Richard Hertwig (Organism. d. Radiol., p. 90, Taf. x. figs. 2, 8, 14). The rich collection of the Challenger has demonstrated that the Aulosphærida belong to the most common and most widely distributed PHÆODARIA; many of them are distinguished by the admirable elegance and astonishing regularity of their large and delicate shell. Nine genera and fifty-six species of this great family are described in the following pages, which, however, may represent only a small part of the numerous forms which are found on the surface as well as in different depths of all oceans and in all zones.

The shell is in the great majority of Aulosphærida a regular sphere or an endospherical polyhedron. Two genera only, both rather rare, exhibit a different monaxonial form, one vertical main axis being developed either more or less than all the other ones of the sphere:—*Aulatractus* is spindle-shaped or ellipsoidal, with prolonged main axis; *Aulophacus* is lenticular or discoidal, with shortened main axis. The former may be compared to the Prunoidea, the latter to the Discoidea, in opposition to the common regular Sphæroidea. The size of the lattice-shell is very considerable in all Aulosphærida, its diameter varying usually between 1 and 3 mm., often it amounts to 4 or 5 mm.; very rarely the diameter is more than 5 or less than 1 mm. The largest form observed is the spindle-shaped *Aulatractus*, in which the vertical prolonged main axis attains 6 to 10 mm., the horizontal equatorial axis 3 to 5 mm.

The network of the lattice-shell exhibits in the Aulosphærida two different types, according to which we distinguish two different subfamilies: Aularida and Aulonida; the former are much more common and richer in remarkable forms than the latter. The meshes of the network are in the Aularida constantly triangular, regular or subregular, and very similar to those of the Sagosphærida; at each nodal point six tangential tubes are usually united, so that the network may be regarded also as composed of regular hexagonal meshes, each of which is divided into six smaller triangular meshes (Pl. 109, figs. 1, 3, 5). The second subfamily, the Aulonida, are much rarer than the former, and are distinguished by the polygonal meshes of the network; these are usually more or less irregular, pentagonal and hexagonal intermingled, more rarely tetragonal, heptagonal, or octagonal; usually three or four, rarely five or more tangential tubes are united at each nodal point (Pl. 111, figs. 1, 3). The size of the meshes is very considerable, and agrees with that of the Sagosphærida; their diameter being usually between 0·1 and 0·3, rarely less or more.

The hollow tubes which compose the loose network are usually cylindrical, straight or slightly curved, smooth (Pl. 111, fig. 2), more rarely somewhat spinulate (Pl. 109,

fig. 5). Their length is usually between 0·1 and 0·2 mm., rarely less than 0·08, or more than 0·24 mm.; their diameter usually between 0·003 to 0·005, sometimes only 0·002 or less, at other times 0·006 or more. In several species the tangential tubes are thinner in the middle part, and thickened towards the two ends (Pl. 109, figs. 3, 4). Each tube consists of a thin cylindrical wall of silex, and of a jelly-mass filling up its cavity; in its axis runs a very thin, straight or slightly curved thread of silica, the axial filament.

The arrangement of the tangential tubes, which originally, in the simplest Aulosphærida, lie tangentially in the spherical face of a simple lattice-sphere, exhibits various secondary modifications, leading to various interesting generic forms. Two genera only, *Aularia* (with triangular meshes, Pl. 111, fig. 2) and *Aulonia* (with polygonal meshes, Pl. 111, fig. 1) possess a smooth, perfectly simple lattice-sphere, and may therefore be regarded as the ancestral genera of the two subfamilies. Two other corresponding genera, the common *Aulosphæra* (Pl. 109) and the rarer *Aulastrum* (Pl. 111, fig. 3), differ from the former in the development of radial spines at the nodal points of the simple lattice-sphere. *Aulophacus* may be developed from *Aulosphæra* by shortening, *Aulatractus*, however, by prolongation of the vertical main axis (Pl. 111, figs. 6, 7). In two genera, *Auloplegma* and *Aulodictyum*, the latticed wall of the spherical shell becomes thickened and spongy, an irregular framework being formed by tubes connected in different directions (Pl. 111, fig. 8). The most remarkable and the most elegant form, however, of the whole family is represented by *Auloscena* (Pl. 110). The entire surface of the spherical lattice-shell is here covered with numerous regular or subregular pyramids, or tent-shaped elevations. Usually each pyramid is six-sided, and surrounded by six other six-sided pyramids, their bases being separated by six triangular meshes, which lie in the spherical face. A similar elegant form is developed among the Sagosphærida in the genera *Sagoscena*, *Sagenoscena* and *Sagoplegma* (Pl. 108, fig. 1). The structure of *Auloscena*, however, is usually more regular, and in the top of each pyramid a radial tube arises.

The junction of the cylindrical tubes at the nodal points of the network is very remarkable. *Aularia*, the simplest form of the family, exhibits at each nodal point the union of six tangential tubes (Pl. 111, fig. 2); their ends are so pointed and truncated that they are connected in the form of a regular six-radiate star; the conical end of each tube is separated from, and at the same time closely connected with, the adjacent conical ends of the two neighbouring tubes by a thin septum, the astral or sutural septum. The six astral septa compose together a six-radiate star, and in the centre of this star the six axial filaments of the tubes are united. Their central union is surrounded by a small, double-contoured circle, and this circle seems to be the perimeter of a small and flat cavity on the inside of the star, which we call shortly the "nodal cavity" ("die kleine Vertiefung" according to Hertwig, *loc. cit.*, p. 90). The nodal cavity of *Aularia* probably possesses a central opening on its inside and six small surrounding pores, which

lead into the six connected tangential tubes. In *Aulosphæra* and *Auloscena*, where a radial spine arises at each nodal point, its axial filament arises from the centre of the star, and is usually prolonged on the inside into a free centripetal beam (Pl. 109, figs. 6, 7; Pl. 110, figs. 4, 6). This centripetal beam is a slender, very thin, conical tube (often with a six-sided pyramidal base) and perhaps of great morphological interest as a rudiment, being homologous to the hollow radial beams which connect the two concentric spheres of the Cannosphærida. Possibly the Aulosphærida have been derived from the latter by loss of the inner shell and reduction of the radial beams; the centripetal beams which are found in many (but not in all) Aulosphærida, may be the last remnant of those radial beams. They contain also an axial filament, as a direct internal prolongation of that of the external radial spine. The axial filaments of the radial spines are usually connected with their thin wall by a variable number of scattered transverse threads, or sometimes even by thin transverse septa (Pl. 110, figs. 4–7, &c.). This structure corresponds to the similar axial filaments and their thin filiform transverse branches which we have found in other PHÆODARIA, *e.g.*, in the Tuscarorida and Circoporida.

The Aulonida (with polygonal meshes) exhibit in general the same structure as the Aularida (with triangular meshes). But whilst in the latter usually six tangential tubes are united at each nodal point, in the former only three or four tubes become united. Therefore also the number of the small sutural partitions or astral septa, which radiate from the central openings of the nodal cavity, is six in the latter, three or four in the former. Correspondingly three or four small pores lead from the nodal cavity into the surrounding tangential tubes.

The true nature of the nodal points, and the intimate structure of the different parts here united, is a matter which it is very difficult to explain. It is a certain fact, well established by hundreds of observations, that in the complete and well-preserved skeletons which are perfectly purified by fire, or by hot mineral acids, and afterwards dried, all the tubes of the skeleton, the tangential as well as the radial cylinders, become filled up by air. Each tube contains usually one large cylindrical air-bubble, with two hemispherical ends. But the air-bubbles of the neighbouring tubes are completely separated one from another by the thin astral or sutural septa, and the air-bubble of the radial tubes is also separated from the former. The central cavity of each nodal point is therefore surrounded in the Aularida by six, in the Aulonida by three or four separate cylinders of air. This fact seems to be explained only on the supposition that each single tube has two terminal pores or fissures, which open into the two nodal cavities on its two ends. The radial tubes must also possess at least one small opening, probably on their base, and probably they have another on their distal apex. In no other way can it be explained, that in all complete, well-preserved and purified skeletons, each single tube constantly becomes easily filled by an air-bubble after drying.

In the living Aulosphærida the cavities of all tubes are filled up by a jelly-substance,

which may be stained by carmine and is probably identical with the jelly of the calymma. The latter is probably in direct connection with the former by the central pore of the nodal cavity, which is placed on its inside and surrounded by the astral septa; these separate the tangential tubes, radiating from one nodal point, completely, and are thin and simple, but very solid lamellæ of silica. Therefore the nodal stars of broken shells usually remain united, whilst the single radiating tubes composing them are broken off (Pl. 110, figs. 3, 8, 10). But it happens only rarely (and only in certain individual species) that complete single tubes separate; usually the fragments of the connected neighbouring tubes remain on their ends. The two small terminal openings of each tangential tube, which lead from its cavity into the nodal cavity, and are surrounded on each end by the truncated ends of two neighbouring astral septa, are very difficult to observe (Pl. 110, figs. 8–10).

The wonderful elegance and the high complication of these regular skeletons of the Aulosphærida, produced by a single cell, becomes increased by the graceful and manifold appendages and apophyses which are usually developed on the radial tubes. In only a few species these are simple, as in the common and cosmopolitan *Aulosphæra trigonopa*. Usually lateral or terminal appendages are developed in great variety, a selection of which is figured in Pls. 109–111. The lateral branches are either irregularly scattered spines (Pl. 110, figs. 3–7) or regular verticils of cruciate or radiate spines; each verticil is usually composed of four perpendicularly crossed horizontal branches (Pl. 109, figs. 3, 4, 7, 10, &c.), more rarely of a greater number of radiating transverse branches.

The terminal appendages of the radial spines exhibit a striking similarity with those of the Aulacanthida (Pls. 102–105). They are either forks with two or three divergent branches (Pl. 111, figs. 3, 4), or regular crosses with four branches opposite in pairs (Pl. 109, figs. 2, 6, 7, 10), or elegant crowns or verticils, composed of numerous radiating branches (Pl. 110, figs. 1–6). The distal ends of the terminal as well as of the lateral branches are either simple, pointed, or armed with a spinulate knob, or with a terminal spathilla. The variety and elegance of these terminal ornaments, the function of which is that of capturing tentacles, is in the Aulosphærida not less admirable than in the Aulacanthida and Cœlodendrida.

The *central capsule* of the Aulosphærida (Pl. 111, fig. 2) was first figured in my Monograph (1862, Taf. xi. fig. 5) of *Aulosphæra elegantissima*, as a sphere of 0·2 to 0·3 mm. in diameter. I described there the large nucleus (of half that size) as a spherical "Binnenblase," and the numerous pseudopodia which arise from the capsule and radiate through the meshes of the lattice-shell. But I had not observed at that time the three typical openings of the capsule, which were first discovered and accurately described by R. Hertwig (1879, *loc. cit.*, p. 94, Taf. x. figs. 2, 4, 5, 8, 14). The large astropyle with its radiate operculum and proboscis, and the two smaller lateral parapylæ, provided with

a smaller tubule, have in general the same shape as in the closely allied Sagosphærida and Orosphærida, and agree in their strong development with that of the Aulacanthida. The collection of the Challenger contains numerous well-preserved preparations of Aulosphærida, which were stained by carmine immediately after being captured, and in which the central capsule and its nucleus exhibit the same intimate structure already accurately described by R. Hertwig. The diameter of the capsule is usually between 0·2 and 0·3, rarely less than 0·15 or more than 0·35 mm., the nucleus has half that size. The phæodium has usually about the same volume (Pl. 109, fig. 1), but seems to be in many Aulosphærida less developed than in the other PHÆODARIA.

*Synopsis of the Genera of Aulosphærida.*

| | | | |
|---|---|---|---|
| I. Subfamily Aularida. Meshes of the network triangular, regular or subregular. Six tangential tubes united at each nodal point of the net. | Shell spherical, with a simple network. | Without radial tubes, | 682. *Aularia.* |
| | | With radial tubes in the nodes of the net, | 683. *Aulosphæra.* |
| | Shell spherical, with pyramidal elevations or with spongy framework. | Shell covered with pyramidal elevations, the top of which bears a radial tube, | 684. *Auloscena.* |
| | | Shell with spongy framework, the surface of which bears radial tubes, | 685. *Auloplegma.* |
| | Shell not spherical, either lenticular or spindle-shaped, with simple network. | Shell lenticular, with shortened main axis and radial tubes, | 686. *Aulophacus.* |
| | | Shell spindle-shaped, with prolonged main axis and radial tubes, | 687. *Aulatractus.* |
| II. Subfamily Aulonida. Meshes of the network polygonal, usually irregular. Three or four (rarely more) tangential tubes united at each nodal point. | Shell spherical, with a simple network. | Without radial tubes, | 688. *Aulonia.* |
| | | With radial tubes in the nodes of the net, | 689. *Aulastrum.* |
| | Shell spherical, with a spongy framework. | Without radial tubes, | 690. *Aulodictyum.* |

## Subfamily 1. AULARIDA, Haeckel.

*Definition.*—Network of the shell with triangular, regular or subregular meshes; six tangential tubes being united at each nodal point.

## Genus 682. *Aularia*,[1] n. gen.

*Definition.*—Aulosphærida with triangular meshes in the network, the tangential tubes of which form a simple smooth lattice-sphere. No radial tubes at the nodal points.

The genus *Aularia* is the simplest form of the subfamily Aularida, or of those Aulosphærida in which the network of the shell is composed of regular or subregular triangular meshes; they are the main group of the family, much more common and far richer in distinct forms than the Aulonida (or the Aulosphærida with polygonal meshes). The shell of *Aularia*, the probable ancestral form of the family, is a simple lattice-sphere with smooth surface, and differs from the common *Aulosphæra* in the absence of radial tubes, arising at the nodal points.

### 1. *Aularia ternaria*, n. sp. (Pl. 111, fig. 2).

Tangential tubes of the network cylindrical, straight, smooth, of equal breadth. Triangular meshes of the reticular sphere very regular, equilateral triangular. This species is the simplest of all Aulosphærida and similar to the common *Aulosphæra trigonopa*, but has no radial tubes.

*Dimensions.*—Diameter of the sphere 1·0 to 2·0; tubes 0·1 to 0·15 long, 0·007 to 0·01 broad.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

### 2. *Aularia tubularia*, n. sp.

Tangential tubes of the network cylindrical, straight, of equal breadth, thorny, covered with numerous short bristle-shaped thorns, which are all of the same length and perpendicular to the tube.

*Dimensions.*—Diameter of the sphere 3·0; tubes 0·15 long, 0·005 broad.

*Habitat.*—South Pacific, Station 291, depth 2250 fathoms.

### 3. *Aularia trigonaria*, n. sp.

Tangential tubes of the network smooth, very thin in the middle part, gradually dilated towards both ends, so that the nodal points of the network are inflated. (Similar to *Aulosphæra sceptrophora*, Pl. 109, fig. 3, but without radial tubes.)

*Dimensions.*—Diameter of the sphere 2·2; tubes 0·1 long, 0·002 broad in the middle part, 0·01 on both sides.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

[1] *Aularia* = Tubular shell; αὐλάρια.

Genus 683. *Aulosphæra*,[1] Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 802.

*Definition.*—Aulosphærida with triangular meshes in the network, the tangential tubes of which form a simple lattice-sphere. Radial tubes arise at its nodal points.

The genus *Aulosphæra*, the first observed form of all Aulosphærida, is also the most common form of the whole family, the richest in distinct species, and widely distributed over all oceans, in the tropical as well as in the temperate and Arctic zones.

The twenty-one species here enumerated may be only a small part of the numerous forms, which may be distinguished according to the different forms of the tubes. One of the two Mediterranean species, which I first described in my Monograph, is cosmopolitan. The shell is in all species a simple regular lattice-sphere with triangular meshes; it differs from the preceding *Aularia* in the development of radial tubes at the nodal points of the lattice-work.

## Subgenus 1. *Aulosphærantha*, Haeckel.

*Definition.*—Radial tubes simple, smooth, without terminal teeth and without lateral branches.

### 1. *Aulosphæra trigonopa*, Haeckel.

*Aulosphæra trigonopa*, Haeckel, 1862, Monogr. d. Radiol., p. 359, Taf. x. fig. 4.

Radial tubes of the spherical shell cylindro-conical, straight, smooth, of the same length as the tangential tubes of the network, which are also smooth, straight, cylindrical.

*Dimensions.*—Diameter of the sphere 1·0 to 2·0; tangential tubes 0·1 to 0·2 long, 0·002 to 0·004 broad.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, surface.

### 2. *Aulosphæra flexuosa*, n. sp.

Radial tubes slenderly conical, smooth, gradually tapering towards the distal end, more or less irregularly curved, two to three times as long as the tangential tubes, which are cylindrical, straight and smooth.

*Dimensions.*—Diameter of the sphere 2·2; tangential tubes 0·15 long, 0·006 broad.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray, surface.

[1] *Aulosphæra* = Tubular sphere; *αὐλός*, *σφαῖρα*.

Subgenus 2. *Aulosphærella*, Haeckel.

*Definition.*—Radial tubes smooth, without lateral branches or spines, but armed with a verticil of teeth at the distal end.

3. *Aulosphæra diodon*, n. sp.

Radial tubes cylindro-conical, straight, smooth, of the same length as the smooth, cylindrical, tangential tubes; armed at the distal end with two divergent terminal teeth, which are slightly curved, pincer-shaped, and about one-fourth as long as the tube.

*Dimensions.*—Diameter of the sphere 2·5; tangential tubes 0·16 long, 0·003 broad.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

4. *Aulosphæra triodon*, n. sp. (Pl. 109, fig. 8).

Radial tubes cylindrical, straight, smooth, two to three times as long as the smooth, cylindrical, tangential tubes; armed at the distal end with three divergent terminal teeth, which are straight or slightly curved and about one-third as long as the tube.

*Dimensions.*—Diameter of the sphere 1·2; tangential tubes 0·1 long, 0·01 broad.

*Habitat.*—North-Eastern Pacific (off Japan), Station 231, surface.

5. *Aulosphæra tetrodon*, n. sp.

Radial tubes slender, cylindrical, straight, smooth, about three times as long as the smooth, cylindrical, tangential tubes; armed at the distal end with a regular cross of four terminal teeth, which are directed almost horizontally, and are slightly recurved (just as in *Aulosphæra spathillata*, Pl. 109, fig. 7, but longer and without lateral verticils).

*Dimensions.*—Diameter of the sphere 1·6; tangential tubes 0·15 long, 0·005 broad.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

6. *Aulosphæra polyodon*, n. sp.

Radial tubes slender, spindle-shaped, gradually tapering towards the two ends, smooth, about twice as long as the cylindrical, smooth, tangential tubes; armed at the distal end with a verticil of twelve to twenty or more divergent, conical, slightly curved teeth.

*Dimensions.*—Diameter of the sphere 3·3; tangential tubes 0·2 long, 0·01 broad.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Subgenus 3. *Aulosphærissa*, Haeckel.

*Definition.*—Radial tubes verticillate, armed with a variable number of regular verticils of lateral branches.

7. *Aulosphæra verticillata*, n. sp.

Radial tubes slender, cylindro-conical, straight, tapering towards the distal end, about as long as the smooth, cylindrical, tangential tubes; armed with eight to twelve verticils of three curved, simple, lateral branches. (Very similar to the tubes of *Aulastrum trichoceros*, Pl. 111, fig. 5*a*.)

*Dimensions.*—Diameter of the sphere 1·6; tangential tubes 0·15 long, 0·008 broad.

*Habitat.*—South Pacific, Station 300, surface.

8. *Aulosphæra spathillata*, n. sp. (Pl. 109, figs. 7, 7*a*).

Radial tubes slender, cylindro-conical, straight, tapering towards the distal end, two to three times as long as the smooth, cylindrical, tangential tubes; armed with two or three distal alternate verticils, each of which forms a horizontal cross of four (sometimes three or five) equidistant branches; their distal ends are on the terminal cross simple hooks, on the proximal cross spathillæ.

*Dimensions.*—Diameter of the sphere 3·2; tangential tubes 0·12 to 0·16 long, 0·01 broad.

*Habitat.*—South-Eastern Pacific (off Valparaiso), Station 298, depth 2225 fathoms.

9. *Aulosphæra cruciata*, Haeckel (Pl. 109, fig. 10).

*Aulosphæra elegantissima*, R. Hertwig (*non* Haeckel), 1879, Organism. d. Radiol., p. 90, Taf. ix. fig. 1; Taf. x. figs. 2, 4, 5, 8, 14, 15.

? *Aulosphæra pourtalesii*, Duncan, 1881, Journ. Roy. Micr. Soc., p. 175, pl. iii. figs. 1–3.

Radial tubes slender, cylindro-conical, straight, tapering towards the distal end, twice as long as the smooth, cylindrical, tangential tubes; armed with four to eight cruciate equidistant verticils, each of which forms a regular cross of four equal, horizontal, lateral branches, bearing at the end a small knob or spathilla.

*Dimensions.*—Diameter of the sphere 1·2 to 1·8; tangential tubes 0·1 to 0·15 long, 0·003 broad.

*Habitat.*—Mediterranean (Messina), North Atlantic (Canary Islands), Caribbean Sea.

10. *Aulosphæra elegantissima*, Haeckel.

*Aulosphæra elegantissima*, Haeckel, 1862, Monogr. d. Radiol., p. 359, Taf. x. fig. 5; Taf. xi. figs. 5, 6.

Radial tubes cylindrical, straight, twice as long as the smooth, cylindrical, tangential tubes; armed with four to eight equidistant verticils, each of which is composed of eight to twelve simple, horizontal, lateral branches.

*Dimensions.*—Diameter of the sphere 1·5 to 2; tangential tubes 0·12 to 0·16 long, 0·004 broad.

*Habitat.*—Mediterranean (Messina), surface.

11. *Aulosphæra bisternaria*, n. sp. (Pl. 109, figs. 11, 12).

Radial tubes cylindrical, straight, about as long as the cylindrical tangential tubes, smooth or somewhat thorny, armed at the distal end with two alternate verticils of three branches, which bear

a terminal spathilla; the proximal branches are twice as long as the distal, and alternate with them regularly, so that the six branches lie in six different meridional planes.

*Dimensions.*—Diameter of the sphere 2·5; tangential tubes 0·2 long, 0·01 broad.

*Habitat.*—Antarctic Ocean, Station 156, surface.

12. *Aulosphæra dendrophora*, n. sp. (Pl. 109, figs. 1, 2).

Radial tubes cylindrical, straight, about as long as the cylindrical, smooth, tangential tubes, armed in the distal half with three verticils of four crossed branches; the four proximal branches are three times as long as the four distal, and twice as long as the four intermediate branches. All twelve branches bear a terminal spinulate knob, and lie in two perpendicularly crossed meridian planes.

*Dimensions.*—Diameter of the sphere 2·2 to 2·8; tangential tubes 0·2 long, 0·01 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

13. *Aulosphæra sceptrophora*, n. sp. (Pl. 109, figs. 3, 4).

Radial tubes straight, in the proximal half conical, with inflated base; in the distal half cylindrical, with five or six cruciate verticils, each of which has four perpendicularly crossed teeth. Tangential tubes half as long as the radial tubes, in the middle part very thin, thickened towards both ends.

*Dimensions.*—Diameter of the sphere 1·2; tangential tubes 0·1 long, 0·002 broad in the middle part, 0·012 on both ends.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

14. *Aulosphæra spathophora*, n. sp.

Radial tubes slender, cylindrical, more or less curved, about three times as long as the tangential tubes, in the distal half with eight to twelve verticils of six to eight lateral branches, which are forked, decrease in length towards the distal end, and bear on each ramule a terminal spathilla. Tangential tubes slightly curved and thorny. (Similar to *Auloplegma perplexum*, Pl. 111, fig. 8*a*, but with a simple lattice-sphere.)

*Dimensions.*—Diameter of the sphere 2·2; tangential tubes 0·2 long, 0·006 broad.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

## Subgenus 4. *Aulosphæromma*, Haeckel.

*Definition.*—Radial tubes spiny or thorny, with irregular lateral branches, often with forked distal ends.

15. *Aulosphæra bifurca*, n. sp.

Radial tubes cylindrical, straight, thorny, twice as long as the smooth, cylindrical, tangential tubes, forked at the distal end, with two curved, convergent, thorny, terminal branches. (Similar to *Aulastrum dendroceros*, Pl. **111**, figs. 4*a*–4*c*, but with longer and more spinulate branches.)

*Dimensions.*—Diameter of the sphere 3·2; tangential tubes 0·25 long, 0·01 broad.

*Habitat.*—North Pacific, Station 239, surface.

16. *Aulosphæra trifurca*, n. sp. (Pl. **109**, fig. 9).

Radial tubes cylindrical, straight, thorny, about as long as the smooth, cylindrical, tangential tubes, forked at the distal end, with three curved, convergent, terminal branches.

*Dimensions.*—Diameter of the sphere 2·5 to 3·0; tangential tubes 0·2 long, 0·01 broad.

*Habitat.*—North Pacific, Station 240, surface.

17. *Aulosphæra quadrifurca*, n. sp.

Radial tubes cylindro-conical, straight, about as long as the smooth, cylindrical, tangential tubes; studded with numerous irregular lateral branches in the distal half, and armed at the distal end with a cross of four divergent, forked, terminal branches.

*Dimensions.*—Diameter of the sphere 4·2; tangential tubes 0·2 long, 0·01 broad.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

18. *Aulosphæra multifurca*, n. sp.

Radial tubes cylindrical, more or less curved, three to four times as long as the smooth, often curved, tangential tubes; studded with numerous forked, irregular, lateral branches, and armed at the distal end with a verticil of twelve to sixteen divergent, forked, terminal branches.

*Dimensions.*—Diameter of the sphere 1·2; tangential tubes 0·06 long, 0·003 broad.

*Habitat.*—Arctic Ocean, Greenland (Olrik), surface.

19. *Aulosphæra coronata*, n. sp.

Radial tubes spindle-shaped, tapering from the thicker middle part towards both ends, twice as long as the thorny tangential tubes, studded with numerous irregular, curved, lateral spines, and bearing at the distal end a corona of twenty to twenty-five divergent, curved, terminal branches. (Similar to *Auloscena flammabunda*, Pl. **110**, fig. 4.)

*Dimensions.*—Diameter of the sphere 3·0; tangential tubes 0·2 long, 0·08 broad.

*Habitat.*—Tropical Atlantic, Station 347, surface.

20. *Aulosphæra undulata*, n. sp. (Pl. 109, fig. 6).

Radial tubes slender, cylindro-conical, undulate, about twice as long as the spinulate and undulate tangential tubes; studded with numerous short, perpendicular, lateral branches which are partly simple, partly forked, and bear small terminal spathillæ. The distal end of each radial tube bears usually a verticil of four to eight similar pediculate spathillæ.

*Dimensions.*—Diameter of the sphere 2·4; tangential tubes 0·2 long, 0·005 broad.

*Habitat.*—North Pacific, Station 252, surface.

21. *Aulosphæra spinosa*, n. sp. (Pl. 109, fig. 5).

Radial tubes and tangential tubes equal in size and similar in form, more or less curved, slender, cylindrical, densely studded with numerous irregular spines.

*Dimensions.*—Diameter of the sphere 1·6; tangential tubes 0·1 long, 0·004 broad.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Genus 684. *Auloscena*,[1] n. gen.

*Definition.*—Aulosphærida with triangular meshes in the network, the tangential tubes of which arise in pyramidal groups of six over the surface of the spherical shell. Radial tubes arise at the tops of the six-sided pyramids, which cover the whole surface.

The genus *Auloscena* differs from the preceding *Aulosphæra*, its ancestral form, in a very remarkable and elegant character. The tangential tubes of the network here lie not on a spherical face (as in the latter), but arise over the surface of the spherical calymma in the form of numerous, regular, hexagonal pyramids; each pyramid being composed of six convergent ascending tubes, which are united in a common nodal point; at the latter arises a radial tube, which usually bears an elegant corona of radially divergent terminal branches. Therefore the base of each hexagonal pyramid is in contact at its six corners with the basal corners of six similar neighbouring pyramids, whilst the neighbouring sides of the bases are separated by six regular triangular meshes, which lie on the spherical face. In some species this remarkable and elegant structure is quite regular, whilst in others it becomes more or less irregular.

### Subgenus 1. *Auloscenium*, Haeckel.

*Definition.*—Radial tubes smooth, without lateral branches or spines, bearing a terminal verticil at the distal end.

[1] *Auloscena* = Tubular tent; αὐλός, σκηνή.

1. *Auloscena mirabilis*, n. sp. (Pl. 110, figs. 1, 2).

Radial tubes cylindrical, straight, smooth, about as long as the smooth pyramidal tubes (or the convergent tubes which form the edges of the six-sided pyramids of the network). The distal end of each radial tube bears an elegant spathillate terminal corona (fig. 2), or a verticil of fifteen to twenty curved radial branches, the distal end of which is armed with a spinulate knob.

*Dimensions.*—Diameter of the sphere 2·0 to 3·0; pyramidal tubes 0·16 to 0·24 long, 0·008 broad.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

2. *Auloscena spectabilis*, n. sp. (Pl. 110, figs. 8, 9).

Radial tubes cylindro-conical, straight, smooth, twice as long as the smooth pyramidal tubes, armed at the distal end with a conical terminal corona, or a verticil of twelve to sixteen divergent, straight, pointed, terminal branches.

*Dimensions.*—Diameter of the sphere 4·0 to 5·0; pyramidal tubes 0·25 to 0·3 long, 0·012 broad.

*Habitat.*—Antarctic Ocean, Station 154, surface.

3. *Auloscena pyramidalis*, n. sp.

Radial tubes slender, conical, straight, smooth, of the same length as the smooth pyramidal tubes, armed at the distal end with a hexagonal terminal corona, or a verticil of six divergent, straight, pointed, terminal branches, which correspond to the six sides of a pyramid; the proximal apex of this terminal pyramid is opposed to the distal apex of the similar basal pyramid.

*Dimensions.*—Diameter of the sphere 3·0 to 4·0; pyramidal tubes 0·2 to 0·3 long, 0·01 broad.

*Habitat.*—Tropical Atlantic, Stations 347 to 349, surface.

## Subgenus 2. *Auloscenidium*, Haeckel.

*Definition.*—Radial tubes thorny, with lateral branches or spines, usually with a terminal verticil at the distal end.

4. *Auloscena tentorium*, n. sp. (Pl. 110, fig. 6).

Radial tubes spindle-shaped, tapering towards both ends, nearly smooth, of the same length as the smooth pyramidal tubes. The distal part of the radial tubes is thorny, and bears a verticil or a corona of twenty to thirty slender terminal branches, which are about one-third as long as the tube, sabre-shaped, with concave outer edge and pointed distal end.

*Dimensions.*—Diameter of the sphere 4·0; radial tubes 0·3 to 0·4 long, 0·02 to 0·03 broad.

*Habitat.*—North-Western Pacific (off Japan), Station 231, surface.

5. *Auloscena verticillus*, n. sp. (Pl. 110, figs. 10, 11).

Radial tubes slender, cylindrical, twice as long as the smooth or somewhat thorny pyramidal tubes, armed in the distal part with two or three irregular verticils of three to six perpendicular spines, and on the distal end with a corona of twelve to eighteen straight, divergent, pointed, terminal branches, which often arise in pairs.

*Dimensions.*—Diameter of the sphere 3·2; pyramidal tubes 0·15 long, 0·01 broad.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

6. *Auloscena penicillus*, n. sp. (Pl. 110, fig. 3).

Radial tubes slender, cylindrical, thorny, one and a half times as long as the thin and smooth pyramidal tubes, armed in the distal half with densely crowded perpendicular spines and a terminal corona of numerous (twenty to thirty or more) bristle-shaped branches, like a brush.

*Dimensions.*—Diameter of the sphere 2·0 to 2·5; radial tubes 0·15 to 0·2 long, 0·005 to 0·01 broad.

*Habitat.*—Antarctic Ocean, Stations 156, 157, surface.

7. *Auloscena flammabunda*, n. sp. (Pl. 110, fig. 4).

Radial tubes cylindro-conical, twice as long as the thorny pyramidal tubes, studded with numerous curved spines, and armed with a verticil or corona of numerous (twenty to thirty or more) undulate, divergent, pointed, terminal branches.

*Dimensions.*—Diameter of the sphere 3·0; radial tubes 0·3 to 0·4 long, 0·02 to 0·03 broad.

*Habitat.*—North Pacific, Station 252, surface.

8. *Auloscena gigantea*, n. sp. (Pl. 110, fig. 7).

Radial tubes cylindrical, thorny, about as long as the thorny pyramidal tubes, armed in the distal half with four to eight verticils of short curved ciliæ, and at the distal end with a similar small terminal verticil.

*Dimensions.*—Diameter of the sphere 5·2; pyramidal tubes 0·2 to 0·3 long, 0·01 broad.

*Habitat.*—Central Pacific, Stations 265 to 268, surface.

9. *Auloscena arboretum*, n. sp.

Radial tubes cylindrical, straight or slightly curved, about the same length as the smooth pyramidal tubes; armed in the distal half with three or four verticils, tapering in size towards the distal end; each verticil is composed of four crossed and curved branches, which bear a terminal spinulate knob. (This species is very similar to *Aulosphæra dendrophora*, Pl. 109, fig. 1, and may

be derived from it by elevation of the hexagonal pyramids, which in the latter lie in the spherical plane).

*Dimensions.*—Diameter of the sphere 4·4; pyramidal tubes 0·25 long, 0·01 broad.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

10. *Auloscena serrata*, n. sp. (Pl. 110, fig. 5).

Radial tubes spindle-shaped, tapering towards both ends, thorny, twice as long as the thorny pyramidal tubes; armed at the distal end with an elegant corona which is composed of twelve to sixteen curved terminal branches. Each branch bears two opposite series of small recurved teeth and a terminal spathilla of six to eight larger recurved teeth.

*Dimensions.*—Diameter of the sphere 3·0; pyramidal tubes 0·3 long, 0·012 broad.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

## Genus 685. *Auloplegma*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Aulosphærida with triangular meshes in the network, the tubes of which are connected in different directions, and form the spongy wall of a spherical shell. Radial tubes arise on the surface at the nodal points.

The genus *Auloplegma*, one of the rarest forms of Aulosphærida, differs from the preceding genera in the spongy structure of the lattice-sphere, the thickened wall of which is composed of a loose framework. Numerous tubes, irregularly disposed in different directions, are connected at the nodal points of this loose spongy framework, whilst radial tubes arise on the surface of the latter. *Auloplegma* exhibits therefore a relation to *Aulosphæra*, its probable ancestral form, similar to that which *Plegmosphæra* does to *Acanthosphæra* among the Sphæroidea.

1. *Auloplegma perplexum*, n. sp. (Pl. 111, figs. 8, 8*a*).

Radial tubes straight, cylindro-conical, armed with six to eight verticils of lateral branches, which increase in size towards the base; each verticil is a cross of four dichotomous delicate ramules, ending with a spinulate knob. The length of the radial tubes is about equal to the radial diameter of the spongy framework, which forms the thick wall of the spherical shell, and is composed of smooth and straight cylindrical tubes.

*Dimensions.*—Diameter of the shell 1·5 to 2·0, of its wall 0·3 to 0·4; length of the radial tubes 0·2 to 0·3, basal breadth 0·015.

*Habitat.*—North Pacific, Station 237, surface.

[1] *Auloplegma* = Tubular framework; αὐλός, πλέγμα.

2. *Auloplegma spongiosum*, n. sp. (Pl. 111, fig. 9).

Radial tubes slender, straight, cylindro-conical, studded irregularly with lateral branches, which are short, simple, slightly curved, partly verticillate in the distal third, and ending with a small spinulate knob. The length of the radial tubes is about twice as great as the radial diameter of the spongy framework, which forms the wall of the spherical shell, and is composed of thorny or verticillate cylindrical tubes.

*Dimensions.*—Diameter of the shell 3·2, of its wall 0·1; length of the radial tubes 0·24, breadth 0·01.

*Habitat.*—North Pacific, Station 231, surface.

## Genus 686. *Aulophacus*,[1] n. gen.

*Definition.*—Aulosphærida with triangular meshes in the network, the tangential tubes of which form a simple, lenticular, biconvex lattice-shell, with shortened vertical main axis. Radial tubes arise at its nodal points.

The genus *Aulophacus* differs from the common *Aulosphæra*, its ancestral form, only in the lenticular compression of the spherical lattice-shell, the vertical axis of which is considerably shortened. It exhibits therefore to the latter the same relation as *Cenodiscus* does to *Cenosphæra* among the Sphæroidea. The contrary condition is shown in the following genus *Aulatractus*, in which the vertical axis is prolonged. In the two species of *Aulophacus* observed the radial spines exhibit a remarkable peculiarity, being longer on the circular periphery of the lens, shorter on both its faces, and shortest in the vertical main axis.

1. *Aulophacus lenticularis*, n. sp. (Pl. 111, fig. 5*a*).

Shell biconvex, lenticular, with rounded circular margin; its horizontal diameter three times as great as its thickness (or its vertical main axis). Radial tubes cylindro-conical, straight, with six to nine triradiate verticils, those of the margin of the lens twice as long as the smooth tangential tubes, the others shorter.

*Dimensions.*—Horizontal diameter of the lens 5·5 mm., vertical main axis 0·2; length of the radial tubes 0·2, breadth 0·01.

*Habitat.*—Indian Ocean, Belligemma, Ceylon (Haeckel) surface.

2. *Aulophacus amphidiscus*, n. sp. (Pl. 111, fig. 5*b*).

Shell discoidal, slightly biconvex, with rounded circular margin; its horizontal diameter five times as great as its thickness. Radial tubes cylindrical, covered with numerous short thorns, those of the margin of the lens three times as long as the smooth tangential tubes, the others shorter.

[1] *Aulophacus* = Tubular lens; *αὐλός*, *φακός*.

*Dimensions.*—Horizontal diameter of the lens 6·0, vertical main axis 1·2; length of the radial tubes 0·2, breadth 0·005.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

## Genus 687. *Aulatractus*,[1] n. gen.

*Definition.*—Aulosphærida with triangular meshes in the network, the tangential tubes of which form an ellipsoidal or spindle-shaped, simple lattice-shell, with prolonged vertical main axis. Radial tubes arise at its nodal points.

The genus *Aulatractus* differs from all the other Aulosphærida in the peculiar prolongation of the vertical axis of the lattice-sphere, by which the latter becomes ellipsoidal or spindle-shaped. The triangular meshes of the regular lattice-work become usually more or less irregular and polygonal at the two poles of the elongated main axis. *Aulatractus* seems to be developed from *Aulosphæra* in the opposite way from *Aulophacus*, the former by elongating, the latter by shortening of the vertical main-axis.

### 1. *Aulatractus fusiformis*, n. sp. (Pl. 111, figs. 6, 6*a*, 6*b*).

Shell spindle-shaped, about twice as long as broad, rounded at both poles of the main axis. Tangential tubes smooth, cylindrical. Radial tubes of the same length as the tangential tubes, but much thinner, slender cylindrical, studded with perpendicularly arising, short, lateral branches, which are scattered in the proximal part, verticillate in the distal part, and bear a spinulate terminal knob.

*Dimensions.*—Length of the shell 7·5 to 10·0, breadth 3·5; length of the radial tubes 0·15 to 0·18, breadth 0·004.

*Habitat.*—Tropical Atlantic, Stations 348, 349; surface, and in various depths.

### 2. *Aulatractus diploconus*, n. sp. (Pl. 111, fig. 7).

Shell diploconical or nearly spindle-shaped, about three times as long as broad, equally pointed at the two poles of the main axis, not inflated in the middle part. Radial tubes slenderly conical, thorny, only half as long as the smooth tangential tubes.

*Dimensions.*—Length of the shell 6·0 to 8·0, breadth 2·2 to 4·5; length of the radial tubes 0·1 to 0·15, breadth 0·007.

*Habitat.*—North Atlantic, Canary Islands, Station 353, surface.

### 3. *Aulatractus fusulus*, n. sp.

Shell spindle-shaped, about twice as long as broad, pointed at the two equal poles of the main axis. Radial tubes cylindro-conical, smooth, about as long as the smooth tangential tubes. This

[1] *Aulatractus* = Spindle composed of tubes; *αὐλός*, *ἄτρακτος*.

species resembles in its simple structure the common cosmopolitan *Aulosphæra trigonopa*, and differs from it only in the constant spindle-form of the shell.

*Dimensions.*—Length of the shell 6 to 8, breadth 3 to 4; length of the radial tubes 0·16 to 0·2, breadth 0·008.

*Habitat.*—North Atlantic, Færöe Channel, Gulf Stream (John Murray); Hebrides (Mœbius).

4. *Aulatractus ellipsoides*, n. sp.

Shell ellipsoidal, about twice as long as broad, with equally rounded poles on the main axis. Radial tubes straight, cylindrical, verticillate, about twice as long as the smooth tangential bars; each verticil is cruciate, composed of four rectangularly crossed, short, lateral branches which bear a small spathilla at the distal end.

*Dimensions.*—Length of the shell 6·6, breadth 3·6; length of the radial tubes 0·2, breadth 0·01.

*Habitat.*—South Atlantic, Station 332, surface.

## Subfamily 2. Aulonida, Haeckel.

*Definition.*—Network of the shell with polygonal, usually irregular meshes; three or four tangential tubes usually being united at each nodal point.

### Genus 688. *Aulonia*,[1] n. gen.

*Definition.*—Aulosphærida with polygonal meshes in the network, the tangential tubes of which form a simple smooth lattice-sphere. No radial tubes at the nodal points.

The genus *Aulonia* is the simplest form of the subfamily Aulonida, or of those Aulosphærida in which the lattice-work of the shell is composed not of triangular but of polygonal meshes; all these Aulonida are much rarer and much less differentiated than the Aularida or the common Aulosphærida with triangular meshes. *Aulonia* has the same simple, smooth, spherical lattice-shell as *Aularia*, and differs from it only in the polygonal form of the meshes, which, however, is very constant.

1. *Aulonia tetragonia*, n. sp.

Meshes regular or subregular, square, sometimes intermingled with a variable number of irregular, triangular, and pentagonal meshes. Bars cylindrical, of equal breadth.

*Dimensions.*—Diameter of the spherical shell 2·0 to 3·2, of the meshes 0·12 to 0·18; breadth of the bars 0·008.

*Habitat.*—Antarctic Ocean, Station 154, depth 1800 fathoms.

[1] *Aulonia*=Tubular object; *αὐλός, ὠνίον.*

2. *Aulonia pentagonia*, n. sp.

Meshes subregular, pentagonal, intermingled with a smaller number of quadrangular and triangular irregular meshes. Bars cylindrical, of equal breadth.

*Dimensions.*—Diameter of the spherical shell 2·8 to 3·2, of the meshes 0·15 to 0·2; breadth of the bars 0·01.

*Habitat.*—South Pacific, Stations 293 to 302, depth 1375 to 2270 fathoms.

3. *Aulonia hexagonia*, n. sp. (Pl. 111, fig. 1).

Meshes regular or subregular, hexagonal, often intermingled with a variable number of pentagonal and heptagonal meshes. Bars cylindrical, of equal breadth.

*Dimensions.*—Diameter of the spherical shell 2·5 to 3·3, of the meshes 0·15 to 0·25; breadth of the bars 0·012.

*Habitat.*—Tropical Atlantic, Stations 347 to 349, surface.

4. *Aulonia metagonia*, n. sp.

Meshes subregularly alternating, larger octagonal and smaller tetragonal. The network of this remarkable species has a striking similarity to the arrangement of the radial tubes in some species of *Sycon*, figured in my Monograph of the Calcispongiæ (1872, Bd. iii., Taf·lx. fig. 12).

*Dimensions.*—Diameter of the sphere 4·4, of the greater octagonal meshes 0·24 to 0·3, smaller tetragonal 0·1 to 0·12; breadth of the bars 0·007.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

5. *Aulonia polygonia*, n. sp.

Meshes irregular, polygonal, variable in form and unequal in size; the majority usually pentagonal or hexagonal, but numerous intermingled meshes with three, four, seven, or eight sides. Very variable in the size of the bars and the form of the meshes.

*Dimensions.*—Diameter of the sphere 2·5 to 5·5, of the meshes 0·1 to 0·2; breadth of the bars 0·008 to 0·12.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, surface.

## Genus 689. *Aulastrum*,[1] n. gen.

*Definition.*—Aulosphærida with polygonal meshes in the network, the tangential tubes of which form a simple lattice-sphere. Radial tubes arise at its nodal points.

[1] *Aulastrus* = Tubular star; *αὐλός, ἀστρον.*

The genus *Aulastrum* differs from the preceding *Aulonia*, its ancestral form, only in the development of radial spines at the nodal points of the simple lattice-sphere. It exhibits therefore to the latter the same relation as *Aulosphæra* does to *Aularia*. But the meshes of the spherical network are constantly triangular in the two latter genera, polygonal in the two former. The different species of *Aulastrum* are much rarer, and are not so differentiated as those of the common *Aulosphæra*.

1. *Aulastrum monoceros*, n. sp.

Radial tubes simple, smooth, straight, cylindro-conical, about as long as the smooth tangential tubes or somewhat longer. Meshes of the network irregularly polygonal, the majority usually pentagonal or hexagonal.

*Dimensions.*—Diameter of the sphere 3·0 to 4·0, of the meshes 0·15; breadth of the tubes 0·012.

*Habitat.*—Tropical Atlantic, Stations 347, 348, depth 2250 to 2450 fathoms.

2. *Aulastrum dichoceros*, n. sp.

Radial tubes cylindrical, more or less curved, undulate, smooth, twice as long as the smooth tangential tubes, forked at the distal end, with two divergent curved branches. Meshes of the network subregular, hexagonal (as in *Aulonia hexagonia*, Pl. **111**, fig. 1), intermingled with single pentagonal and square meshes.

*Dimensions.*—Diameter of the sphere 2·0 to 2·5, of the meshes 0·12 to 0·18; breadth of the tubes 0·01.

*Habitat.*—Antarctic Ocean, Station 157, depth 1950 fathoms.

3. *Aulastrum dendroceros*, n. sp. (Pl. **111**, figs. 4*a*, *b*, *c*).

Radial tubes cylindrical, straight or slightly curved, thorny, forked at the distal end, two to three times as long as the thorny tangential tubes; the thorns are short and thin, partly simple, partly irregularly branched and scattered, arborescent. Meshes of the network irregularly polygonal, the majority pentagonal or tetragonal.

*Dimensions.*—Diameter of the sphere 2·4; radial tubes 0·2 to 0·3 long, 0·02 broad.

*Habitat.*—North Pacific, Station 241 to 244, surface.

4. *Aulastrum triceros*, n. sp. (Pl. **111**, figs. 3, 3*a*).

Radial tubes cylindrical, straight, smooth, about twice as long as the smooth tangential tubes, armed with three divergent curved teeth at the distal end. Meshes subregular, pentagonal, intermingled with a small number of tetragonal and hexagonal meshes.

*Dimensions.*—Diameter of the sphere 1·2 to 1·8; radial tubes 0·15 long, 0·01 broad.

*Habitat.*—Tropical Atlantic, Station 349, depth 2450 fathoms.

5. *Aulastrum trichoceros*, n. sp.

Radial tubes slender, straight, cylindro-conical, about twice as long as the smooth tangential tubes, armed with six to eight verticils of lateral branches, each of which is composed of three short curved branches (similar to those of *Aulophacus lenticularis*, Pl. **111**, fig. 5*a*). Meshes irregularly polygonal, the majority tetragonal, intermingled with pentagonal and triangular meshes.

*Dimensions.*—Diameter of the sphere 2·2; tangential tubes 0·12 long, 0·007 broad.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

6. *Aulastrum tetraceros*, n. sp.

Radial tubes straight, cylindrical, about three times as long as the smooth tangential meshes, armed with three to six subregular cruciate verticils of branches, each of which is composed of four short, regularly crossed branches, bearing at the end a spinulate knob (similar to those of *Aulatractus fusiformis*, Pl. **111**, fig. 6*b*). Meshes subregular, square, intermingled with single pentagonal and hexagonal meshes.

*Dimensions.*—Diameter of the sphere 1·5, of the meshes 0·12 to 0·16; breadth of the bars 0·008.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

7. *Aulastrum pentaceros*, n. sp.

Radial tubes straight, cylindrical, smooth, about as long as the smooth tangential tubes, armed at the distal end with a corona of five curved teeth (of the same shape as in *Cannosphæra atlantica*, Pl. **112**, fig. 6). Meshes subregular pentagonal (intermingled with single tetragonal, hexagonal, and heptagonal meshes).

*Dimensions.*—Diameter of the sphere 5·0, of the meshes 0·2; breadth of the bars 0·015.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

8. *Aulastrum polyceros*, n. sp.

Radial tubes spindle-shaped, tapering from the broader middle towards both ends, spiny, twice as long as the spiny tangential tubes, armed at the distal end with a corona of twelve to twenty divergent curved teeth (similar to the radial tubes of *Auloscena tentorium*, Pl. **110**, fig. 6). Meshes irregular, polygonal, very variable in size and form. All tubes of this species are armed with scattered, short, conical spines.

*Dimensions.*—Diameter of the sphere 4·5, of the meshes 0·1 to 0·2; breadth of the bars 0·006.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

Genus 690. *Aulodictyum*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Aulosphærida with polygonal meshes in the network, the tubes of which are connected in different directions and form the spongy wall of a spherical shell. No radial tubes prominent over the surface.

The genus *Aulodictyum* differs from *Aulonia*, its ancestral form, in the development of a spongy framework in the thickened wall of the spherical lattice-shell. It bears therefore to the latter the same relation as *Auloplegma* does to *Aularia*. But the outer surface of the hollow sphere is in *Aulodictyum* completely smooth, as well as the inner, and bears no radial tubes. Only one species of this genus has been observed.

1. *Aulodictyum hydrodictyum*, n. sp.

Shell spherical, smooth on the outer and inner surfaces, composed of an irregular framework of straight and smooth cylindrical tubes; its meshes very irregular, of unequal size and various forms. The diameter of the sphere is about six or eight times as great as the thickness of its reticular wall.

*Dimensions.*—Diameter of the sphere 2 to 3, of its meshes 0·1 to 0·2; breadth of the bars 0·01.

*Habitat.*—Antarctic Ocean, Station 157, depth 1950 fathoms.

## Family LXXVII. Cannosphærida, Haeckel (Pl. 112).

*Cannosphærida*, Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Phæodaria with two concentric spherical or subspherical shells, which are connected by numerous thin, tubular, radial beams. Inner shell simple, spherical or ovate, solid or latticed, with a peculiar mouth. Outer shell spherical or polyhedral, articulate, composed of hollow tangential tubes, which are separated by astral septa at the stellate nodal points. From the latter arise hollow radial tubes, whilst the inner radial beams, connecting the two shells, are inserted in the middle of the tangential tubes. No peculiar mouth in the outer shell. Central capsule enclosed by the inner shell.

The family Cannosphærida comprises a small number of remarkable Phæodaria which are rare and found only in a few localities. They differ from all the other Phæodaria in the possession of two concentric spherical shells, which are connected by radial beams, and the inner of which is quite simple, like that of the Medusettida,

[1] *Aulodictyum* = Tubular net; αὐλός, δίκτυον.

whilst the outer is articulated and composed of hollow tangential tubes, like that of the Aulosphærida. This latter family seems to be most nearly allied to the Cannosphærida, and is perhaps derived from them by loss of the inner shell. The possession of a peculiar mouth in this inner shell brings the Cannosphærida nearer to the Phæogromia. The similar Cœlodrymida, in which also two concentric sphærical shells are connected by hollow radial beams, differ essentially in the bivalved shape of the inner shell and the simple, non-articulated, network of the outer shell.

Only a single species of Cannosphærida has been hitherto known, described and figured in 1879 by R. Hertwig as *Cœlacantha anchorata* (*loc. cit.*, p. 92, Taf. ix. fig. 2). The rich collection of the Challenger has added to it only four other species, one of which is most nearly allied to the former, whilst the others belong to a separate genus, *Cannosphœra* (Pl. 112). The inner shell is in this latter genus a solid lamella of silica, whilst in the former it is fenestrated. In all other essential points of structure both genera are scarcely different.

The inner shell is either spherical or ovate and has a diameter of 0·1 to 0·4 (usually 0·2 to 0·3 mm.). A distinct main axis is always marked by the large open mouth on its oral pole. The aboral part of the shell-cavity contains the spherical central capsule, the oral part the dark phæodium, a part of which is often prominent through the mouth (figs. 1, 2, 4). The wall of the inner shell is a very thin and transparent lamella of silica, which is structureless and solid in *Cannosphœra*, distinctly fenestrated in *Cœlacantha;* the pores of the latter are irregularly rounded and seem to possess a thickened margin.

From the surface of the inner shell arise numerous thin, tubular, radial beams (twenty to eighty or more) and connect it with the outer shell. These beams are always very thin and straight cylindrical tubules, about twice to four times as long as the diameter of the inner shell, and usually 0·001 mm. broad, or even less. Their basal end at their origin from the inner shell is more or less dilated, often funnel-shaped, so that the surface of the latter appears mammillated (figs. 2, 4). The cavity of the inner shell seems to pass over immediately into the tubular cavities of the radial beams. These latter are sometimes simple, at other times articulated or jointed by a number of transverse septa. The radial beams are covered in all the species observed either with scattered spines (fig. 5) or with verticils of anchor-threads, very thin, filiform, lateral branches which bear a spathilla with three or four recurved teeth on the distal end (figs. 2, 4).

The outer shell is either spherical or an endospherical polyhedron, the prominent nodal points of which fall into a spherical face. Its diameter is usually from 2 to 3 mm., rarely more than 3 or less than 1 mm. Its structure is the same as described for the Aulosphærida, being composed of hollow cylindrical tubes, which form a loose network and are separated at its nodal points by astral septa. The meshes of the network are

very large, usually twice to three times as broad as the inner shell, and irregularly polygonal; the usual and prevailing form is pentagonal, but hexagonal meshes are also often intermingled, more rarely meshes with four, seven, or eight sides.

The cylindrical tangential tubes possess in general the same shape as in the similar Aulosphærida, have a thin wall, are filled by jelly, and contain a delicate axial filament in their axis; they differ, however, in a peculiar constant character; in the middle of each tube is inserted an inner radial beam coming from the inner shell, so that both together have the form of a T. The central point of insertion has a somewhat shorter radial distance from the centre of the body than the two nodal points on both ends of the tangential tube, so that the latter is slightly geniculate (figs. 1–5). The two halves of each tangential tube are usually somewhat thinner on the central end (where the inner radial beam is inserted), thicker on the distal end (where the outer radial tube arises); at both ends they are closed by a thin transverse septum. Often also some other septa are developed, so that each tangential tube seems to be composed of four to six joints or segments. Usually the tangential tubes are armed with spines or anchor-threads, similar to those of the inner radial beams. The length of the single tangential tubes is usually between 0·1 and 0·3, their diameter from 0·01 to 0·02.

The nodal points of the outer lattice-sphere, in which the outer radial spines arise, seem to possess the same structure as in the similar Aulosphærida. Since three tangential tubes are connected in each nodal point, in its centre is the union of three small astral septa or sutural partitions. The small nodal cavity on the inside of the nodal point has probably three small pores, which lead into the three tangential tubes between the three astral septa. A fourth pore probably leads from the nodal cavity into the cavity of the hollow radial tube. This structure is difficult to observe, but seems to be demonstrated by the fact, that in the complete and carefully purified skeletons which are treated with hot mineral acids and afterwards dried, all cylinders, the tangential as well as the radial tubes, become easily filled by air (compare the description of the similar structure in the Aulosphærida).

The external radial tubes which arise in the nodal points of the outer shell are either cylindrical or cylindro-conical, straight, and usually about as long as the diameter of the inner shell. Their structure and armature is the same as in the similar Aulosphærida. In the axis of each radial tube runs a delicate axial filament, which is connected with its thin and fragile wall either by filiform transverse branches or by delicate transverse septa. The outside of the radial tubes is either smooth (figs. 3–5) or armed with scattered spines (fig. 4) or with verticils of lateral branches; each verticil is usually composed of three or four branches. The distal end of the radial tubes is rarely simple, pointed; it is usually armed with a spathilla of three or four curved terminal branches (figs. 3, 5) sometimes with an elegant corona composed of twenty to thirty thin radially divergent branches (fig. 4).

The *central capsule* of the Cannosphærida is small (of 0·1 to 0·15 in diameter) and hidden in the aboral half of the enclosing inner shell, whilst the oral half of the latter is filled up by the phæodium (figs. 2, 4). The structure of the capsule and of its three openings seems to be the same as in the closely allied Aulosphærida. I have, however, not been able to recognise the two parapylæ or secondary openings, and have only observed the astropyle or the main-opening with its radiate operculum surrounded by the phæodium, and directed with its tubular proboscis towards the mouth of the inner shell. As R. Hertwig also could not recognise the two parapylæ, it is not impossible that they are wanting, and that the Cannosphærida possess only one opening, the astropyle, like the Medusettida and Challengerida. The nucleus, enclosed in the central capsule, is spherical, half or one-third as broad as the latter, and contains numerous nucleoli.

*Synopsis of the Genera of Cannosphærida.*

| | |
|---|---|
| Internal shell solid, without open pores, . . . . . | 691. *Cannosphæra.* |
| Internal shell latticed, with open pores, . . . . . | 692. *Cœlacantha.* |

Genus 691. *Cannosphæra*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Cannosphærida with a solid, not latticed internal shell.

The genus *Cannosphæra* comprises those Cannosphærida in which the inner shell is formed by a thin solid siliceous-plate and exhibits no pores between the prominent bases of the radial beams.

1. *Cannosphæra atlantica*, n. sp. (Pl. **112**, figs. 5, 6).

Internal shell not mammillate, with fifteen to twenty radial rods, which are loosely studded with single, scattered, simple, lateral spines. External shell with irregular, mostly hexagonal meshes, armed with numerous scattered forks of paired divergent spines, and with twenty to thirty larger simple radial spines, which are about half as long as the internal rods, and bear at the distal end a verticil of three to five curved, simple, terminal branches.

*Dimensions.*—Diameter of the inner shell 0·1, of the outer 0·5.

*Habitat.*—Tropical Atlantic, Stations 347 to 349, depth 2250 to 2450 fathoms.

2. *Cannosphæra antarctica*, n. sp. (Pl. **112**, figs. 1–3).

Internal shell mammillate, with sixty to ninety radial rods, which are studded with cruciate verticils of tridentate anchor-threads. External shell with irregular, mostly pentagonal meshes,

[1] *Cannosphæra*=Sphere with tubules; κάννα, σφαῖρα.

the bars of which bear on the outside bunches of similar tridentate anchor-threads. At each nodal point arises a simple, smooth, radial spine, which bears at the distal end a verticil of three or four small, curved, terminal branches.

*Dimensions.*—Diameter of the inner shell 0·2 to 0·3, of the outer 1·5 to 2·0.

*Habitat.*—Antarctic Ocean, Stations 154 to 157, depth 1300 to 1975 fathoms.

### 3. *Cannosphæra pacifica*, n. sp. (Pl. 112, fig. 4).

Internal shell mammillate, with one hundred to one hundred and twenty radial rods, which are studded with cruciate verticils of tridentate anchor-threads. External shell with irregular, mostly hexagonal meshes, the bars of which bear on the outside and on the inside bunches of similar tridentate anchor-threads. At each nodal point arises a simple, thorny, radial spine, which bears at the distal end an elegant verticil of fifteen to twenty flatly expanded, thin, terminal branches.

*Dimensions.*—Diameter of the inner shell 0·25 to 0·35, of the outer 2·0 to 2·5.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

## Genus 692. *Cœlacantha*,[1] R. Hertwig, 1879, Organism. d. Radiol., p. 91.

*Definition.*—Cannosphærida with a latticed internal shell.

The genus *Cœlacantha* comprises those Cannosphærida in which the inner shell is formed by a fenestrated flint-plate, and exhibits numerous pores between the prominent bases of the radial beams.

### 1. *Cœlacantha anchorata*, R. Hertwig.

*Cœlacantha anchorata*, R. Hertwig, 1879, Organism. d. Radiol., p. 92, Taf. ix. fig. 2.

Internal shell slightly mammillate, with thirty to forty radial rods, which are densely studded with verticils of tridentate anchor-threads. External shell with irregular, mostly pentagonal meshes, the bars of which bear the same verticils, each composed of three thin, tridentate anchor-threads. At each nodal point arises a slender radial spine, which bears six verticils, each composed of three to five lateral branches.

*Dimensions.*—Diameter of the inner shell 0·5, of the outer 3·0.

*Habitat.*—Mediterranean, Messina (R. Hertwig), surface,

### 2. *Cœlacantha mammillata*, n. sp.

Internal shell strongly mammillate, with sixty to eighty radial rods, which are densely studded with cruciate verticils of quadridentate anchor-threads. External shell with irregular, mostly

[1] *Cœlacantha* = Hollow spine ; κοιλός, ἄκανθα.

hexagonal meshes, the bars of which bear the same verticils, each composed of four thin quadridentate anchor-threads. At each nodal point arises a slender, smooth, radial spine, which bears at its distal end a verticil of four large, curved, terminal branches.

*Dimensions.*—Diameter of the inner shell 0·4, of the outer 3·2.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

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## Order III. PHÆOGROMIA, Haeckel, 1879.

*Definition.*—PHÆODARIA with a simple, not bivalved lattice-shell, which assumes very different forms, but is always provided with a peculiar mouth and peristome on the oral pole of the main axis. Central capsule always excentric, placed in the aboral half of the shell-cavity.

### Family LXXVIII. CHALLENGERIDA, John Murray (Pl. 99).

*Challengerida*, John Murray, 1876, Proc. Roy. Soc. Lond., vol. xxiv. p. 471, pl. xxiv. figs. 1, 2.

*Definition.*—PHÆODARIA with a monaxonial, usually ovate or lenticular shell, which exhibits a peculiar, fine, regularly hexagonal, diatomaceous structure, and is usually provided with teeth on the mouth, but without articulated feet. Central capsule excentric, placed in the aboral half of the shell-cavity.

The family Challengerida represent a large, peculiar, and interesting group of PHÆODARIA, which are, for the most part, inhabitants of great depths, and were perfectly unknown before the discoveries of the Challenger. The first note on these remarkable Radiolaria was given in 1876 by John Murray, in his Preliminary Reports on Work done on board the Challenger (Proc. Roy. Soc. Lond., vol. xxiv. pp. 471, 536, pl. xxiv. figs. 1, 2). He described the peculiar exceedingly beautiful tracery of their shell, similar to that of the Diatomaceæ, the enclosed central capsule coloured by carmine, and the surrounding mass of black-brown pigment lumps (the phæodium). "At times these Challengerida come up with a good deal of sarcode outside of the shell, and two specimens have been seen to throw out elongated pseudopodia" (*loc. cit.*, p. 536). He found also the shells in the Radiolarian ooze of the deep sea. The number of different forms found in the collection of the Challenger is so great, that I can describe in the following pages not less than six genera and fifty-eight species. A part of these have already been figured by Dr. John Murray in the Narrative of the Challenger Expedition, vol. i. p. 226, Pl. A, 1885.

In my first preliminary note on the PHÆODARIA, in 1879, I gave a stricter definition

of the Challengerida (Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, 1879, p. 5). But I united at that time the true Challengerida with the Tuscarorida, which, however, are sharply separated by the entirely different structure of their shell. In Plate A given by Dr. John Murray, and mentioned above, figs. 1–14 represent genuine Challengerida, with diatomaceous shell-structure, whilst figs. 15–20 are Tuscarorida, with porcellanous shell-structure. These latter, therefore, are more closely allied to the Circoporida, whilst the Challengerida exhibit a closer affinity to the Medusettida and Castanellida. But the two latter families never possess that peculiar extremely regular and delicate diatomaceous structure which is exhibited only by the Challengerida.

The general form of the Challengerida is rather simple, usually more or less ovate, sometimes nearly triangular, at other times subspherical. In nearly all species, with a few exceptions, the shell is more or less compressed from the two sides, so that its horizontal transverse section is not circular, but elliptical or lanceolate. In many species the shell is more or less lenticular, with a sharp or sometimes keeled margin. This margin lies in the sagittal plane of the body, whilst the two flat sides are right and left. The main axis is always perpendicular, and its oral or anterior pole is marked by the open mouth of the shell; the latter is in the living organism probably the upper pole, whilst the opposite aboral or posterior pole (often marked by large spines) is the lower pole. The dorsal margin of the mouth is usually different from the ventral, and in the majority of species this difference is so striking, that right and left sides of the body may be recognised immediately, the fundamental form being dipleuric or bilaterally-symmetrical. In a few species, however, and mainly in those simplest forms in which the ovate shell has a circular mouth without teeth, and a circular transverse section, that difference is not recognisable, and the ovate shell is monaxonial, as it is in *Gromia* and *Lagena* among the Foraminifera (Pl. 99, figs. 19, 20, 22). The size of the shell is in the majority of species between 0·2 and 0·5 mm.; there are, however, some very small species, in which the diameter of the shell is only 0·05 to 0·08, or even less; and some large species, the diameter of which attains 0·8 to 0·9 mm.

The peculiar structure of the siliceous shell-wall, which we call shortly "diatomaceous," and by which the Challengerida differ from all the other PHÆODARIA, has been already represented very well by Dr. John Murray, in Pl. A. of the Narrative (vol. i. p. 266, figs. 1*c*–1*e*, 2*a*, 4*a*, 7*a*, 7*b*). This elegant diatomaceous structure is extremely similar or nearly identical with that well-known regular structure which we find in the common Diatomaceæ or Bacillariæ. The entire surface of the shell is covered with a very great number of very small pit-like depressions, perfectly regular, circular in form, equal in size, and quincuncial in arrangement. The neighbouring equidistant pits are always surrounded by regular hexagonal frames of equal size, and the prominent fine crests of these frames produce the regular hexagonal tracery, which gives to the shell such a striking similarity to that of the Diatomaceæ. According to

the different positions to which the focus of the microscope is brought, the hexagonal tracery exhibits a different appearance; either a regular network of equal hexagonal frames, or a lattice with equal and equidistant circular openings, or a combination of three crossed and equidistant systems of parallel lines (crossed at angles of 120°). All the well-known and often discussed optical phenomena which are observed in the valves of the Diatomaceæ, reappear also on the shell of the Challengerida.

To recognise the true nature of this diatomaceous structure, sections and slides of the shell are required, and also fragments of broken shells, the broken margins of which are of special value for obtaining further explanation. The figures given by Dr. J. Murray (*loc. cit.*, Pl. A) have already demonstrated that the pit-like depressions are regular small cavities in the flinty shell-wall, which possess an inner and an outer opening. These intraparietal cavities are either spherical (fig. 7*b*) or cylindrical (fig. 1*d*, 4*a*) or spindle-shaped, with a constriction (fig. 2*a*). Further accurate examinations probably will show a greater variety in their shape. But each cavity constantly possesses two small openings, one on the outer, and the other on the inner surface of the shell-wall. Closer examination (especially of broken shells and slides) proves the presence of these two openings, which in the smaller species seem to be absent on the first view. I may, therefore, suppose that also in the similar valves of the Diatomaceæ, which exhibit exactly the same structure, an inner and an outer opening are always present in each hexagonal pit, and that the very small size alone prevents them from being recognised. The regular hexagonally-framed cavities in the shell-wall of the Challengerida (probably also of the Diatomaceæ) are therefore genuine pores, differing from the pores of other Radiolaria only in their smaller size and the dilatation of the middle part, which is much wider than the two openings.

The mouth of the shell, its single larger opening, exhibits in the various Challengerida a great variety in form and structure, and offers the best means for separating genera and species. According to its essential shape two different subfamilies and six genera may be distinguished in this family. In the first subfamily, Lithogromida, the mouth is a simple large opening in the wall of the shell on the oral pole of its main axis (Pl. 99, figs. 1–15). In the second subfamily, Pharyngellida, the mouth is prolonged into a cylindrical hollow tube, which is prominent into the shell-cavity, and comparable to the pharynx of the Metazoa in general form and function (Pl. 99, figs. 16–20). In this case we may distinguish an inner and an outer mouth of the tubular pharynx.

In a few forms of both subfamilies the mouth is toothless, smooth, and not armed with prominent external spines or teeth, as in *Lithogromia*, the simplest form of all (Pl. 99, fig. 22) and in *Entocannula* (figs. 19, 20). In the great majority of Challengerida, however, the outer opening of the mouth is armed with one or more teeth, usually strong prominent spines (figs. 1–18). Usually the base of these teeth is

semitubular or a half cylinder, forming a more or less prominent peristome or a proboscis; and always in this case the open concave side of the canal-shaped groove is directed towards the ventral side of the shell, the closed convex side towards the dorsal side. When several teeth arise from the two lateral free margins of the groove, they are also directed towards the ventral side (figs. 2, 12, 17, &c.). Often a deep ventral incision or a guttural constriction separates the base of the proboscis from the genuine shell. The structure of this proboscis or peristome is usually the same as in the diatomaceous shell-wall; but sometimes its lattice-work assumes a different shape.

The opening of the mouth itself is rarely circular, usually it is elliptical or even lanceolate, often triangular. Sometimes two prominent opposite lips may be distinguished as right and left, when the fissure of the mouth is prolonged in a sagittal or longitudinal direction; as upper and lower, when it is prolonged in a frontal or transverse direction. The upper or dorsal lip is always more developed than the lower or ventral; and the entire semitubular proboscis may be regarded as a production of the upper lip. Sometimes the latter attains an extraordinary size and development, the greatest in *Challengeria murrayi* (Pl. 99, fig. 1).

The teeth of the mouth, which arise from the upper lip, are usually hollow, at least on the base; a prolongation of the shell-cavity arising into the base of the teeth. Their form is very variable, conical, lanceolate, triangular, sabre-shaped, &c. Usually they are more or less curved, and shorter than the radius of the shell; rarely they are straight, and longer than the radius (Pl. 99, figs. 5, 6). More important is their different number, which we have employed for the distinction of subgenera; future observations may prove that they are different genera. The most important are the following cases: —(A.) a single odd dorsal tooth (figs. 5, 16); (B.) two paired lateral teeth (figs. 4, 6, 17); (C.) three teeth, an odd dorsal and two paired lateral (figs. 7, 9, 10); (D.) four paired teeth, two dorsal and two ventral (figs. 3, 13); (E.) five teeth, an odd dorsal and two pairs of lateral (figs. 2, 12); (F.) six teeth in three lateral pairs (fig. 1).

The teeth of the peristome are not the only apophyses which arise from the shell of the Challengerida. In the majority other spines appear on the sagittal margin, which separates the right and left halves of the shell. These marginal spines are characteristic of the genera *Challengeron* and *Porcupinia;* they are usually radially directed, straight, conical, sometimes solid, at other times hollow. Their number and arrangement is very variable and serves for the distinction of species; the following differences are the most important :—(A.) a single odd spine on the apical pole of the shell, in the principal axis, opposite to the centre of the mouth (Pl. 99, figs. 6, 7); (B.) two aboral spines, a dorsal and a ventral (figs. 8–10); (C.) a bunch or a crowded group of radial spines on the aboral margin of the shell, usually one larger apical spine surrounded by several smaller dorsal and ventral (figs. 11, 12, 16); (D.) numerous radial spines along the whole sagittal margin of the shell (figs. 13–15).

The *central capsule* of the Challengerida is constantly placed in the aboral half of the shell-cavity, whilst its oral half is occupied by the phæodium; the intervals between them and the inner surface of the shell are filled up by the calymma. Frequently from the outer surface of the capsule arise numerous branched streams of sarcode, which pierce the calymma and are directed towards the inside of the shell-wall, where they are united by a thin continuous layer of protoplasm (Pl. 99, fig. 1). The phæodium is usually more voluminous than the capsule and envelops the latter on its anterior or oral face; more rarely the entire capsule is hidden in the phæodium. The phæodella, constituting the latter, are of very different sizes, of variable colour, olive and greenish-brown, red-brown, black-brown or nearly black. In some preparations, stained with carmine, numerous red coloured granula, similar to nuclei, were scattered in the phæodium (compare Murray, *loc. cit.*, Pl. A, figs. 1–14).

The diameter of the central capsule is usually about one-half or one-third as great as that of the enclosing shell (Pl. 99, figs. 1–20). Its form is either spherical or slightly compressed, spheroidal, or sometimes lenticular. The large nucleus has the same form, is about half as broad as the capsule and contains numerous nucleoli. Sometimes the capsule contained two nuclei of equal size, and in a few specimens the shell contained two central capsules, each with a nucleus, so that the Challengerida seem to propagate also by self-division (Pl. 99, fig. 6).

The astropyle, or the large opening of the central capsule, exhibits the usual radiate operculum of the PHÆODARIA, and the tubular proboscis arising from it. This is constantly placed on the oral or anterior pole of the capsule and directed towards the mouth of the shell. I was never able to discover any parapyle or secondary opening in the central capsule, though numerous and well-preserved specimens of the Challenger collection were accurately examined. It seems therefore that the Challengerida are not TRIPYLEA (as the majority of PHÆODARIA), but MONOPYLEA with a single opening (like the closely allied Medusettida and Castanellida).

### *Synopsis of the Genera of Challengerida.*

| | | | |
|---|---|---|---|
| I. Subfamily Lithogromida. Shell without pharynx or inner prominent tube of the mouth. | Shell smooth, without adoral teeth and marginal spines, | 693. | *Lithogromia.* |
| | Shell with adoral teeth, but without marginal spines, | 694. | *Challengeria.* |
| | Shell with adoral teeth and with marginal spines, | 695. | *Challengeron.* |
| II. Subfamily Pharyngellida. Shell with a pharynx, or an inner cylindrical tube, arising from the mouth and prominent inside. | Shell smooth, without adoral teeth and marginal spines, | 696. | *Entocannula.* |
| | Shell with adoral teeth, but without marginal spines, | 697. | *Pharyngella.* |
| | Shell with adoral teeth and with marginal spines, | 698. | *Porcupinia.* |

## Subfamily 1. LITHOGROMIDA, Haeckel.

*Definition.*—Challengerida without pharynx, with a simple mouth, not prolonged into an inner prominent tube.

### Genus 693. *Lithogromia*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Challengerida without pharynx, without adoral teeth and marginal spines.

The genus *Lithogromia* and the two following genera represent together the subfamily Lithogromida, comprising those Challengerida in which the mouth of the shell is a simple opening, and not prolonged into a pharynx or an internal prominent tube. *Lithogromia* may be regarded as the common ancestral form of this family, since it is the simplest of all, and possesses no external apophyses, neither teeth on the mouth, nor spines on the margin of the smooth shell.

1. *Lithogromia silicea*, n. sp. (Pl. 99, fig. 22).

Shell ovate, one and a half times as long as broad, not compressed. Transverse section circular. Mouth a simple circular opening with smooth edges about one-third as broad as the shell.

*Dimensions.*—Length of the shell 0·2, breadth 0·15; mouth 0·05.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray, depth 600 fathoms.

2. *Lithogromia diatomacea*, n. sp. (Pl. 99, fig. 21).

Shell ovate, lenticular, one and one-third times as long as broad, strongly compressed. Transverse section elliptical. Mouth a broad fissure, half as broad as the shell.

*Dimensions.*—Length of the shell 0·27, breadth 0·2; mouth 0·1.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

3. *Lithogromia lenticula*, n. sp.

Shell subcircular, lenticular, about as long as broad, strongly compressed. Transverse section lanceolate. Mouth a narrow fissure, one-third as broad as the shell.

*Dimensions.*—Diameter of the shell 0·15, mouth 0·05.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

[1] *Lithogromia*=Siliceous *Gromia*.

Genus 694. *Challengeria*, John Murray, 1876, Proc. Roy. Soc. Lond., vol. xxiv. p. 536.

*Definition.*—Challengerida without pharynx, with one or more adoral teeth, but without spines on the sagittal margin.

The genus *Challengeria*, and the following closely allied *Challengeron*, differ from the preceding *Lithogromia*, their ancestral form, in the development of teeth on the mouth of the shell. *Challengeron* has also radial spines on the sagittal margin, while these are wanting in *Challengeria*. The latter genus exhibits not less than twenty-one, the former twenty-five species, so that both together make by far the greatest part of the family (containing fifty-eight species). They are also more common and more widely distributed than the four other genera of Challengerida, and many species appear in great numbers in certain localities. With a few exceptions living on the surface, they are all inhabitants of great depths.

Subgenus 1. *Challengerantha*, Haeckel.

*Definition.*—Peristome with a single simple tooth, which is neither forked nor branched (*Challengeriæ monodontes*).

1. *Challengeria naresii*, John Murray.

*Challengeria naresii*, John Murray, 1876, Proc. Roy. Soc. Lond., vol. xxiv. pl. xxiv. fig. 1.
*Challengeria naresii*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 236, pl. A, figs. 1, 1*a*–1*e*.

Shell circular or nearly circular, strongly compressed, lenticular. Peristome on the dorsal corner with a single simple vertical tooth, which is nearly straight, conical, with two sharp lateral edges on the base, about half as long as the shell.

*Dimensions.*—Diameter of the shell 0·5 to 0·6, length of the tooth 0·2 to 0·3.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific, at depths between 1000 and 3000 fathoms.

2. *Challengeria xiphodon*, n. sp.

Shell circular, nearly spherical, slightly compressed. Peristome on the dorsal corner with a single simple vertical tooth, which is straight, three-sided prismatic, and as long as the shell.

*Dimensions.*—Diameter of the shell 0·1 to 0·13, length of the tooth 0·1 to 0·12.

*Habitat.*—Tropical Atlantic, Stations 349 to 352, surface.

3. *Challengeria sigmodon*, n. sp.

Shell circular, nearly spherical, slightly compressed. Peristome with a single simple tooth, which is S-shaped, more or less curved, and about one-third as long as the shell.

*Dimensions.*—Diameter of the shell 0·3 to 0·4, length of the tooth 0·1 to 0·14.

*Habitat.*—North Pacific, Station 231, depth 2250 fathoms.

4. *Challengeria tritonis*, n. sp. (Pl. 99, fig. 5).

Shell ovate, slightly compressed. Peristome with a single simple tooth, which is vertical, straight, slenderly conical, and about half as long as the shell.

*Dimensions.*—Diameter of the shell 0·15 to 0·2, length of the tooth 0·1 to 0·12.

*Habitat.*—North Atlantic, Færöe Channel, Gulf Stream, in great numbers, in depths from 100 to 600 fathoms. (Expedition of H.M.S. "Triton," 1882), John Murray.

5. *Challengeria pyramidalis*, n. sp.

Shell slenderly ovate, one and a half times as long as broad, slightly compressed. Peristome with a single, simple, large tooth, which is three-sided pyramidal, vertical, straight, and longer than half the shell.

*Dimensions.*—Length of the shell 0·6 to 0·8, breadth 0·4 to 0·5; length of the tooth 0·4 to 0·5.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

6. *Challengeria cyrtodon*, n. sp.

Shell ovate, lenticular, strongly compressed. Peristome with a single simple tooth, which is crescent-shaped, curved over the mouth, and about half as long as the shell.

*Dimensions.*—Length of the shell 0·4 to 0·5, breadth 0·3 to 0·4; length of the tooth 0·2 to 0·25.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

## Subgenus 2. *Challengeretta*, Haeckel.

*Definition.*—Peristome with a forked or bifid tooth, or with two parallel lateral teeth (*Challengeriæ diodontes*).

7. *Challengeria sloggettii*, John Murray (Pl. 99, fig. 4).

*Challengeria harstoni*, John Murray, 1879 (*partim*), *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 14.

Shell triangular, strongly compressed, with three rounded corners, or nearly semicircular; its aboral margin straight, horizontal, longer than the convex, dorsal, and ventral margins. Peristome

with two parallel, triangular pointed teeth, which are obliquely ascending, lamellar, with inflated ovate base, and about as long as the shell-radius.

*Dimensions.*—Diameter of the shell 0·2 to 0·3, length of the teeth 0·1 to 0·15.

*Habitat.*—Tropical Atlantic, Stations 347, 348, depth 2250 to 2450 fathoms.

### 8. *Challengeria harstoni*, John Murray.

*Challengeria harstoni*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 14*a*.

Shell subcircular or somewhat triangular, with convex margins. Peristome with two parallel, slender, lanceolate teeth, which are obliquely ascending, and about half as long as the shell-radius.

*Dimensions.*—Diameter of the shell 0·15 to 0·18, length of the teeth 0·04 to 0·05.

*Habitat.*—North Pacific, Station 231, depth 2250 fathoms.

### 9. *Challengeria campbelli*, John Murray.

*Challengeria campbelli*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 9.

Shell cordate, nearly triangular, compressed, with blunt apex. Peristome in the excavated middle of the broad base, with two short, parallel, triangular teeth. This species is very similar to *Porcupinia cordiformis* (Pl. **99**, fig. 16), but differs from it in the absence of an internal pharynx and of external apical spines.

*Dimensions.*—Diameter of the shell 0·2 to 0·24; length of the teeth 0·03 to 0·05.

*Habitat.*—South Atlantic, Stations 332 to 335, depth 1425 to 2200 fathoms.

### 10. *Challengeria thomsoni*, John Murray.

*Challengeria thomsoni*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 2.

Shell ovate, slightly compressed, with rounded apical pole. Peristome semitubular, obliquely ascending, nearly straight, in the lower half an open half-cylinder, in the upper half forked, with two parallel, thin, oblique teeth. Sometimes a third small (dorsal) tooth is developed.

*Dimensions.*—Length of the shell 0·3 to 0·35, breadth 0·2 to 0·25; length of the peristome 0·08 to 0·12.

*Habitat.*—South Atlantic, Stations 318 to 330, surface, and in depths from 1900 to 2900 fathoms.

### 11. *Challengeria bidens*, n. sp.

Shell ovate, strongly compressed, lenticular. Peristome with two curved, long and thin bristle-shaped teeth, which are obliquely inclined over the mouth, and longer than the radius of the shell.

*Dimensions.*—Length of the shell 0·12 to 0·18, breadth 0·1 to 0·14; length of the teeth 0·08 to 0·1.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

### 12. *Challengeria havergalli*, John Murray.

*Challengeria havergalli*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, figs. 13, 13*a*.

Shell subspherical, slightly compressed. Peristome semitubular, slender, somewhat curved, in the lower half a simple half-cylinder, in the upper half forked, with two divergent teeth, nearly as long as the shell.

*Dimensions.*—Diameter of the shell 0·1 to 0·15, length of the peristome 0·08 to 0·12.

*Habitat.*—South Pacific, Station 300, depth 1375 fathoms.

### 13. *Challengeria elephas*, n. sp.

Shell ellipsoidal, not compressed. Peristome very similar to that of *Challengeron diodon* (Pl. **99**, fig. 6), from which this species differs mainly in the absence of an apical spine, and in a more constricted mouth. The two conical teeth of the mouth are very large, nearly as long as the shell, straight, and almost parallel, each tooth has a large hole on the thickened base.

*Dimensions.*—Diameter of the shell 0·22, length of the teeth 0·2.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

## Subgenus 3. *Challengerilla*, Haeckel.

*Definition.*—Peristome with three teeth or trifid, with an odd dorsal and two paired lateral teeth (*Challengeriæ triodontes*).

### 14. *Challengeria macleari*, John Murray.

*Challengeria macleari*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 3.

Shell subcircular, lenticular, with a sharp marginal edge. Peristome semitubular, an oblique half-cylinder, with three divergent, short, triangular teeth; the dorsal odd tooth nearly vertical, the paired lateral teeth subhorizontal. Length of the peristome about one-third or one-fourth of the diameter of the shell.

*Dimensions.*—Diameter of the shell 0·25 to 0·35, length of the peristome 0·1 to 0·12.

*Habitat.*—South Atlantic, Stations 325 to 332, depth 1715 to 2900 fathoms.

### 15. *Challengeria tridens*, n. sp.

Shell subspherical, slightly compressed. Peristome about as long as the radius of the shell, with three diverging and obliquely descending teeth; the dorsal odd tooth twice as long as the paired lateral teeth.

*Dimensions.*—Diameter of the shell 0·08 to 0·12, length of the peristome 0·05 to 0·07.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray.

16. *Challengeria trigona*, Haeckel.

*Challengeria macleari*, var., John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 3*b*.

Shell triangular, with three rounded corners; the two lateral sides nearly straight, equal, the aboral side more or less convex and somewhat shorter. Peristome a curved half-tube (often longer than in Murray's figure), one-third to one-half as long as the shell, with three short triangular diverging and ascending teeth of equal length.

*Dimensions.*—Length of the shell 0·25 to 0·3, breadth 0·2 to 0·25; length of the peristome 0·08 to 0·12.

*Habitat.*—South Atlantic, Stations 332 to 335, depth 1425 to 2200 fathoms.

17. *Challengeria trifida*, n. sp.

Shell ovate, more or less compressed, about two-thirds as long as broad. Peristome semi-tubular, obliquely ascending, about one-third as long as the shell, in the lower half simple, in the upper trifid, with three curved divergent teeth; the dorsal odd tooth shorter than the paired lateral teeth.

*Dimensions.*—Length of the shell 0·3 to 0·36, breadth 0·24 to 0·28.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

## Subgenus 4. *Challengeromma*, Haeckel.

*Definition.*—Peristome with four to six or more teeth.

18. *Challengeria quadridens*, n. sp.

Shell subglobose, with nearly circular perimeter. Peristome an oblique short and broad tube, the breadth of which is twice as great as its length and equal to the radius of the shell. Margin of the peristome with four divergent, short, triangular teeth, the two dorsal teeth half as long as the two ventral.

*Dimensions.*—Diameter of the shell 0·22 to 0·24, breadth of the peristome 0·1.

*Habitat.*—Central Pacific, Stations 265 to 268, depth 2700 to 2900 fathoms.

19. *Challengeria bromleyi*, n. sp. (Pl. 99, fig. 3).

Shell ovate, lenticular, strongly compressed. Peristome a broad, trapezoidal, horizontal lamella, the breadth of which is twice as great as its length and nearly equal to the diameter of the shell; its margin with four divergent triangular lamellar teeth, the two dorsal teeth three times as long as the two ventral.

*Dimensions.*—Length of the shell 0·08 to 0·1, breadth 0·05 to 0·07; breadth of the peristome 0·08.

*Habitat.*—North Pacific, Stations 244 to 253, surface, and in various depths.

20. *Challengeria wildi*, n. sp. (Pl. 99, fig. 2).

Shell subspherical, slightly compressed. Peristome semitubular, curved, as long as the shell-radius; with five curved lamellar teeth, an odd longer dorsal tooth and two pairs of lateral teeth.

*Dimensions.*—Diameter of the shell 0·12 to 0·18, length of the peristome 0·08 to 0·12.

*Habitat.*—Tropical Atlantic, Stations 347 to 348, depth 2250 to 2450 fathoms.

21. *Challengeria aldrichi*, John Murray.

*Challengeria aldrichi*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 4.

Shell subspherical, slightly compressed. Peristome a collar-like curved lamella, the breadth of which is twice as great as its length, and equals the radius of the shell; its margin with six short triangular teeth, two convergent ventral, two external horizontal lateral, and two ascending dorsal.

*Dimensions.*—Diameter of the shell 0·2, breadth of the peristome 0·1.

*Habitat.*—North Pacific, Station 244 to 248, depth 2050 to 2900 fathoms.

22. *Challengeria murrayi*, n. sp. (Pl. 99, fig. 1).

Shell subcircular, lenticular, strongly compressed. Peristome a trapezoidal, curved, collar-like lamella, the breadth of which is three times as great as its length and equal to the diameter of the shell; its margin with six triangular teeth, disposed like the preceding species, but larger.

*Dimensions.*—Diameter of the shell 0·15, breadth of the peristome 0·15.

*Habitat.*—North-Western Pacific (south of Japan), Station 231, depth 2250 fathoms.

Genus 695. *Challengeron*, John Murray, 1879, *in litteris et schedulis.*

*Definition.*—Challengerida without pharynx, with one or more teeth on the mouth, and with marginal spines.

The genus *Challengeron* has in general the same shape as the preceding closely allied *Challengeria*, but differs from it in the development of radial spines on the sagittal margin of the shell, which in the latter genus is smooth. According to the different number and arrangement of these marginal spines, which give a very singular appearance to them, we divide the twenty-five species of this cosmopolitan genus into four subgenera :—(1) with a single, odd apical spine ; (2) with two opposed aboral spines (a dorsal and a ventral); (3) with a bunch of aboral spines; (4) with numerous radial spines along the whole sagittal margin of the shell.

Subgenus 1. *Challengeranium*, Haeckel.

*Definition.*—Margin of the shell with a single spine on the apical pole, opposite to the peristome (*Challengeriæ caudatæ*).

1. *Challengeron monodon*, n. sp.

Shell subspherical, slightly compressed, with a single straight conical spine on the apical pole, about as long as the radius. Peristome with a single vertical, straight, conical tooth, diametrically opposite to the apical spine and of the same length. (Similar to *Challengeria naresii*.)

*Dimensions.*—Diameter of the shell 0·2 to 0·3, length of the two opposite spines 0·1 to 0·15.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

2. *Challengeron cochlear*, n. sp.

Shell nearly circular, lenticular, strongly compressed, with a single straight conical spine on the apical pole, about half as long as the radius. Peristome spoon-shaped, obliquely curved and inclined over the mouth, with a single terminal tooth, somewhat longer than the radius.

*Dimensions.*—Diameter of the shell 0·1, length of the peristome 0·06.

*Habitat.*—Indian Ocean, Cocos Islands, Rabbe, surface.

3. *Challengeron diodon*, n. sp. (Pl. 99, fig. 6).

Shell ovate, slightly compressed, with a single straight conical spine on the aboral pole, half as long as the radius. Peristome short and broad, collar-shaped, about twice as broad as long, and half as long as the radius, obliquely inclined over the mouth, with two divergent straight teeth, which are conical and longer than the shell-radius; beyond each tooth a large ovate hole in the wall of the peristome.

*Dimensions.*—Diameter of the shell 0·08 to 0·1, length of the teeth 0·06 to 0·08.

*Habitat.*—South-Eastern Pacific, Station 298, depth 2225 fathoms.

4. *Challengeron pearceyi*, n. sp. (Pl. 99, fig. 7).

Shell ellipsoidal or subspherical, scarcely compressed, with a single straight conical spine on the apical pole, about as long as the diameter. Peristome slender, semitubular, nearly as long as the diameter, somewhat obliquely inclined over the mouth, with three divergent triangular or lanceolate teeth; the dorsal odd tooth about twice as large as the paired lateral teeth.

*Dimensions.*—Diameter of the shell 0·08 to 0·12, length of the peristome 0·08 to 0·1.

*Habitat.*—Antarctic Ocean, between Kerguelen and Heard Island, Station 157.

5. *Challengeron swirei*, John Murray.

*Challengeria swirei*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 11.

Shell subspherical or somewhat ovate, with a single straight conical spine on the apical pole, about as long as the radius. Peristome slender, semitubular, straight and vertical, nearly as long as the shell, with three pointed teeth, an odd longer terminal and two paired shorter lateral.

*Dimensions.*—Diameter of the shell 0·06 to 0·08, length of the peristome 0·05 to 0·06.

*Habitat.*—Antarctic Ocean, Station 157, surface, common.

6. *Challengeron triodon*, n. sp.

Shell ovate, one and a half times as long as broad, not compressed, with a single short and stout conical spine on the apical pole, shorter than half the radius. Peristome short and broad, collar-shaped, nearly half as broad and one-third as long as the shell, with three divergent terminal teeth, an odd dorsal and two paired lateral.

*Dimensions.*—Length of the shell 0·25 to 0·3, breadth 0·15 to 0·2; length and breadth of the peristome 0·1.

*Habitat.*—North Pacific, Station 245, surface.

## Subgenus 2. *Challengerebium*, Haeckel.

*Definition.*—Margin of the shell with two widely distant aboral spines, opposite in the sagittal plane, a dorsal and a ventral.

7. *Challengeron balfouri*, John Murray.

*Challengeria balfouri*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 10.

Shell subcircular, lenticular, strongly compressed, with two short divergent spines on the apical margin (a dorsal and a ventral). Peristome slender, semitubular, as long as the radius, vertical, in the distal half forked, with two parallel teeth.

*Dimensions.*—Diameter of the shell 0·08 to 0·16, length of the peristome 0·04 to 0·08.

*Habitat.*—North Atlantic, Stations 353 to 354, Hebrides, surface.

8. *Challengeron golfense*, n. sp.

Shell ovate, lenticular, compressed, with two short divergent spines on the apical margin (a dorsal and a ventral). Peristome slender, semitubular, half as long as the radius, with three terminal teeth, two short, vertically ascending, paired teeth and a larger odd tooth, which is inclined obliquely over the mouth.

*Dimensions.*—Diameter of the shell 0·15 to 0·2, peristome 0·05 to 0·07.

*Habitat.*—North Atlantic, Færöe Channel, Gulf Stream, surface and at various depths, John Murray.

9. *Challengeron richardsii*, n. sp. (Pl. 99, fig. 8).

Shell subcircular, lenticular, strongly compressed, with two stout, divergent, straight spines on the aboral margin (a dorsal and a ventral) which reach the length of the radius. Peristome slender, semitubular, slightly curved, about as long as the radius, with three short, divergent,

terminal teeth. Mouth obliquely truncate. The dorsal odd tooth is nearly vertical, the two lateral paired teeth almost horizontal.

*Dimensions.*—Diameter of the shell 0·2 to 0·25, length of the spines and the peristome 0·08 to 0·12.

*Habitat.*—Antarctic Ocean, Station 157, surface, common.

### 10. *Challengeron fergusoni*, n. sp. (Pl. 99, fig. 9).

Shell isosceles triangular, with three slightly convex edges and two short, nearly vertically descending spines on the two corners of the aboral margin. Peristome inversely funnel-shaped, with a deep ventral incision on the base, and three broad, ovate, triangular teeth. The dorsal odd tooth is nearly vertical, whilst the two lateral paired teeth are almost horizontal; therefore the angle between the former and the latter is about a right angle.

*Dimensions.*—Diameter of the shell 0·2 to 0·3, length of the peristome 0·1.

*Habitat.*—Western Tropical Pacific, Station 224, depth 1850 fathoms.

### 11. *Challengeron tizardi*, John Murray.

*Challengeria tizardi*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, figs. 7–7*b*.

Shell nearly equilateral triangular, with concave ventral, convex dorsal and aboral edges, on the two corners of the latter two opposite horizontal spines (a dorsal and a ventral). Peristome auriculate and bilobate, with a deep ventral incision on the base, and three pointed triangular teeth, the upper margins of which are nearly horizontal.

*Dimensions.*—Diameter of the shell 0·22 to 0·3, length and breadth of the peristome 0·01 to 0·12.

*Habitat.*—South Atlantic, Stations 332 to 335, depth 1425 to 2200 fathoms.

### 12. *Challengeron triangulum*, n. sp. (Pl. 99, fig. 10).

Shell nearly equilateral triangular, with three slightly convex or nearly straight sides, and two opposite obliquely descending and diverging spines on the two corners of the aboral margin. Peristome auriculate and bilobate, with a very thin basal neck and a deep incision on its ventra side; its distal margin is obliquely truncate, and exhibits an odd ascending dorsal tooth and two parallel, paired, descending, lateral teeth.

*Dimensions.*—Diameter of the shell 0·2 to 0·3; length and breadth of the peristome 0·1 to 0·12.

*Habitat.*—North Pacific, Stations 244 to 253, depth 2050 to 3125 fathoms.

## Subgenus 3. *Challengeridium*, Haeckel.

*Definition.*—Margin of the shell smooth on the dorsal and the ventral side, but with three to five or more large spines (or a bunch of spines) on the aboral side; the middle spine is placed in the main axis, and larger than the others.

13. *Challengeron bisternum*, n. sp.

Shell subcircular, lenticular, strongly compressed, with three stout conical spines on the aboral pole; the middle spine is placed in the main axis, as long as the radius and three times as long as the two others. Peristome semitubular, straight, vertical, about as long as the radius, with three divergent teeth, the middle of which is odd and twice as large as the two paired lateral teeth.

*Dimensions.*—Diameter of the shell 0·22; length of the peristome 0·1.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

14. *Challengeron heptacanthum*, n. sp.

Shell ovate, slightly compressed, with a series of five stout, conical, radial spines on the aboral margin; the middle spine is placed in the main axis and longer than the radius, twice as long as the two next, and three times as long as the more distant spines. Peristome short and broad, collar-shaped, with two large, divergent, straight teeth, each of which is longer than the shell-radius and bears at its base a large hole.

*Dimensions.*—Length of the shell 0·09 to 0·11, breadth 0·07 to 0·08; length of the teeth 0·07.

*Habitat.*—Tropical Atlantic, Stations 347, 348, depth 2250 and 2450 fathoms.

15. *Challengeron crosbiei*, n. sp. (Pl. 99, fig. 11).

Shell ovate, strongly compressed, with a series of seven to nine conical spines on the aboral margin; the middle spine is placed in the main axis, as long as the radius, and much larger than the six or eight other spines. Peristome short and broad, collar-like, with several small spines and two slender, widely distant, conical teeth, which are half as long as the shell, and curved towards one another like a pincer, each with a large hole at its base.

*Dimensions.*—Length of the shell 0·08 to 0·09, breadth 0·06 to 0·07; length of the two larger teeth 0·04 to 0·05.

*Habitat.*—Central Pacific, Station 270 to 274, depth 2350 to 2925 fathoms.

16. *Challengeron buchanani*, n. sp. (Pl. 99, fig. 12).

Shell ovate, slightly compressed, with a terminal comb of nine to twelve conical radial spines, densely crowded on the aboral pole; the middle spine is placed in the main axis, about half as long as the shell and much larger than the others. Peristome subconical, semitubular, recurved, half as long as the shell, with five triangular teeth; the dorsal odd tooth is inclined backwards, the two parallel pairs of lateral teeth directed ventrally.

*Dimensions.*—Length of the shell 0·15 to 0·18, breadth 0·1 to 0·12; length of the peristome 0·06 to 0·08.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

## Subgenus 4. *Challengerosium*, Haeckel.

*Definition.*—Margin of the shell dentated or serrated, with a continuous series of numerous short radial spines.

### 17. *Challengeron channeri*, John Murray.

*Challengeron channeri*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 12.

Shell subcircular, lenticular, strongly compressed, with fourteen to eighteen slender, straight, radial spines on the margin; the spines are straight, equidistant, cylindrical, and about as long as the radius of the shell. Peristome short, with two parallel, vertical, lateral, straight teeth, which are less than half the length of a spine.

*Dimensions.*—Diameter of the shell 0·14 to 0·17; length of the spines 0·06 to 0·08.

*Habitat.*—North Pacific, Station 231, depth 2250 fathoms.

### 18. *Challengeron moseleyi*, n. sp. (Pl. 99, fig. 14).

Shell circular, lenticular, strongly compressed, with thirty to forty slender, straight, equidistant, radial spines on the margin, larger and smaller spines alternating; the larger spines are about as long as the radius, the smaller only half as long. Peristome short, tubular, with two divergent ovate or nearly triangular teeth, a dorsal and a ventral, about as long as the shorter marginal spines.

*Dimensions.*—Diameter of the shell 0·13 to 0·15; length of the larger spines 0·6 to 0·07, of the smaller 0·03 to 0·04.

*Habitat.*—North Pacific, Station 244, depth 2900 fathoms.

### 19. *Challengeron bethelli*, John Murray.

*Challengeron bethelli*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 6.

Shell subcircular, lenticular, strongly compressed, with numerous (twenty to thirty) short conical spines on the margin (often wanting in the upper part of the dorsal margin). Peristome with a deep labial incision and two parallel triangular lateral teeth, the upper margin of which is horizontal.

*Dimensions.*—Diameter of the shell 0·2 to 0·25; length of the spines 0·02 to 0·03.

*Habitat.*—North Pacific, Stations 238, 241 (off Japan), depth between 2300 and 3950 fathoms.

### 20. *Challengeron bathybium*, n. sp.

Shell subcircular, lenticular, slightly compressed, with a corona of numerous (thirty to forty or more) short, conical, radial spines on the margin. Peristome helmet-shaped, nearly as long as the

radius, with two widely divergent, conical, curved teeth, a vertical dorsal and a nearly horizontal ventral tooth.

*Dimensions.*—Diameter of the shell 0·22; length of the peristome 0·1.

*Habitat.*—Western Tropical Pacific, Station 225, depth 4475 fathoms.

### 21. *Challengeron johannis*, n. sp.

Shell ovate, slightly compressed, with a corona of numerous (forty to sixty or more) short radial spines on the margin, ten to fifteen of them (in the aboral half) are pyramidal, and much larger than the others. Peristome helmet-shaped, about one-third as long as the shell, with a deep bosom and two widely divergent teeth on the concave upper margin, a forked dorsal and a conical ventral.

*Dimensions.*—Length of the shell 0·13, breadth 0·1; length of the peristome 0·04.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray.

### 22. *Challengeron carpenterii*, John Murray.

*Challengeron carpenterii*, John Murray, 1877, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 8.

Shell ovate, with a series of twelve to fifteen short, conical, radial spines on the aboral half of the margin. Peristome slender, semitubular, nearly as long as the shell, in the upper half forked, with two short parallel teeth.

*Dimensions.*—Length of the shell 0·13 to 0·18, breadth 0·1 to 0·14; length of the peristome 0·1 to 0·12.

*Habitat.*—Tropical Atlantic, Stations 347 to 348, depth 2250 to 2450 fathoms.

### 23. *Challengeron ciliatum*, n. sp.

Shell ovate, slightly compressed, with numerous (forty to fifty or more) short and thin, bristle-shaped, radial spines on the margin. Peristome obliquely truncate, with three curved spines; the dorsal odd spine subvertical, nearly as long as the radius, and much stronger than the two parallel, nearly horizontal, lateral spines.

*Dimensions.*—Length of the shell 0·15, breadth 0·11; length of the peristome 0·1.

*Habitat.*—North Pacific, Station 231, depth 2250 fathoms.

### 24. *Challengeron willemoesii*, n. sp. (Pl. 99, fig. 13).

Shell broadly-ovate or nearly circular, lenticular, with numerous (fifty to sixty) short and stout, conical, radial spines on the margin, increasing in size towards the aboral pole; the spines are alternately larger and smaller, the largest about half as long as the radius. Peristome helmet-shaped or half conical, longer than the radius of the shell, with two pairs of conical, curved,

divergent teeth; the terminal teeth are the halves of a forked dorsal tooth and diverge laterally; the lower teeth are nearly horizontal and directed ventrally.

*Dimensions.*—Diameter of the shell 0·13 to 0·15; length of the peristome 0·07 to 0·1.

*Habitat.*—Tropical Pacific, Stations 274 to 276, depth 2350 to 2750 fathoms.

25. *Challengeron wyvillei*, n. sp. (Pl. 99, fig. 15).

Shell ovate, lenticular, strongly compressed, with numerous (forty to fifty) short, conical, radial spines on the margin; the spines are larger on the aboral side and spinulate. Peristome narrow, with two parallel, lateral, lamellar, forked teeth, about as long as the radius; the upper branch of the forks is sabre-shaped, obliquely truncate, subvertical, ciliate, and much broader than the lower nearly horizontal branch, which is directed towards the ventral side and curved upwards.

*Dimensions.*—Length of the shell 0·12 to 0·16, breadth 0·1 to 0·14; length of the peristome 0·08 to 0·11.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

## Subfamily 2. PHARYNGELLIDA, Haeckel.

*Definition.*—Challengerida with a pharynx, or an internal prominent mouth tube.

### Genus 696. *Entocannula*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Challengerida with a pharynx, without teeth on the mouth, and without marginal spines.

The genus *Entocannula* and the two following genera represent together the subfamily Pharyngellida, differing from the preceding Lithogromida in the development of a peculiar pharynx, an internal, cylindrical, or funnel-shaped tube, which is conspicuous, leads from the mouth into the shell-cavity, and is provided with an inner and an outer opening. The Pharyngellida are much rarer than the Lithogromida; only ten species have been observed of the former, fifty of the latter. *Entocannula* is the simplest form of the Pharyngellida, having a smooth shell, without aboral teeth and marginal spines; it differs from *Lithogromia* only in the possession of the pharynx. One remarkable species is covered entirely with extremely thin, flinty hairs, and may represent therefore a peculiar genus, *Trichogromia*.

[1] *Entocannula* Shell with an internal tube.

1. *Entocannula circularis*, n. sp.

Shell circular or nearly circular, lenticular, strongly compressed. Pharynx cylindrical, one-third or one-fourth as broad as the shell, twice as broad as long, its outer and inner apertures of equal breadth. Surface smooth.

*Dimensions.*—Diameter of the shell 0·20 to 0·32, of the pharynx 0·07 to 0·09.

*Habitat.*—North Pacific, Station 250, depth 3050 fathoms.

2. *Entocannula subglobosa*, n. sp.

*Challengeria bromleyi*, (*partim*), John Murray, 1879, *in schedulis* Chall. Coll.

Shell circular, nearly spherical, slightly compressed. Pharynx funnel-shaped, truncate, conical, its outer opening twice as broad as the inner. Surface smooth.

*Dimensions.*—Diameter of the shell 0·25 to 0·28, of the inner mouth 0·05.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

3. *Entocannula infundibulum*, n. sp. (Pl. 99, fig. 19).

*Challengeria bromleyi* (*partim*), John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 5.

Shell ovate, truncate at the mouth, slightly compressed. Pharynx funnel-shaped, its outer aperture two to three times as broad as the inner. Surface smooth.

*Dimensions.*—Length of the shell 0·22 to 0·28, breadth 0·2 to 0·25; inner mouth 0·04 to 0·08.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

4. *Entocannula hirsuta*, n. sp. (Pl. 99, fig. 20).

*Trichogromia hirsuta*, Haeckel, 1881, Manuscript.

Shell ovate. Pharynx cylindrical, one-fourth as broad as the shell, its inner and outer apertures of equal breadth. The whole surface of the shell, and mainly the outer mouth, is densely covered with thin, curved, siliceous bristles.

*Dimensions.*—Length of the shell 0·27 to 0·36, breadth 0·2 to 0·3; mouth 0·05 to 0·08.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray, depth 600 fathoms.

## Genus 697. *Pharyngella*,[1] n. gen.

*Definition.*—Challengerida with a pharynx, and with one or more teeth on the mouth, but without marginal spines.

The genus *Pharyngella* differs from the preceding *Entocannula*, its ancestral form, in the development of one or more teeth on the peristome, and exhibits therefore the same relation to it that *Challengeria* bears to *Lithogromia*. Only a few species of this genus have been observed, all in the Atlantic.

[1] *Pharyngella* = Shell with an internal pharynx.

1. *Pharyngella monoceros*, n. sp.

Shell ovate, slightly compressed, with a single large tooth on the dorsal corner of the peristome. The tooth is cylindro-conical, half as long as the shell, straight or slightly curved, and lies in the main axis of the shell. Pharynx cylindrical, straight, half as long as the shell-radius. This species is very similar to *Challengeria tritonis* (Pl. 99, fig. 5), and to the common cosmopolitan *Challengeria naresii*, but differs generically from them in the possession of the pharynx.

*Dimensions.*—Diameter of the shell 0·25 to 0·28; length of the tooth 0·14.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

2. *Pharyngella gastrula*, n. sp. (Pl. 99, fig. 18).

Shell ovate. Peristome with two parallel, vertical, straight, pointed teeth, which are half as long as the shell-radius. Pharynx of the same length, cylindrical or funnel-shaped, its outer aperture scarcely broader than the inner.

*Dimensions.*—Length of the shell 0·3 to 36, breadth 0·24 to 0·3; teeth and pharynx 0·07 to 0·09.

*Habitat.*—North Atlantic, Færöe Channel (Gulf Stream), John Murray, depth 600 fathoms.

3. *Pharyngella invaginata*, n. sp.

Shell circular, slightly compressed or nearly spherical. Peristome with two parallel, vertical, straight, pointed teeth, which are about as long as the shell-radius. Pharynx of the same length, funnel-shaped; its outer aperture twice as broad as the inner.

*Dimensions.*—Diameter of the shell 0·2 to 0·22, teeth and pharynx 0·05.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

4. *Pharyngella gastræa*, n. sp. (Pl. 99, fig. 17).

Shell broad, ovate or nearly circular, lenticular, strongly compressed. Peristome with two parallel, pointed teeth, which are nearly as long as the shell-radius, slightly curved, and obliquely inclined over the mouth. Pharynx half as long, cylindrical, obliquely descending; its outer and inner apertures of equal breadth.

*Dimensions.*—Diameter of the shell 0·3 to 0·33, teeth 0·12, pharynx 0·06.

*Habitat.*—South Atlantic, Stations 328 to 334, surface.

## Genus 698. *Porcupinia*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Challengerida with a pharynx, with teeth on the mouth and marginal spines.

The genus *Porcupinia* differs from the preceding *Pharyngella* in the development

[1] *Porcupinia*, in memory of H.M.S. "Porcupine" by which the first British deep-sea explorations were carried out during the years 1869 and 1870.

of marginal spines, and exhibits therefore the same relation to it that *Challengeron* bears to *Challengeria*. Only two species have been observed; the first of these bears, besides the large marginal spines, numerous flinty bristles on the surface of the shell.

1. *Porcupinia aculeata*, n. sp.

Shell ovate, one and one-third times as long as broad, slightly compressed, covered with short, bristle-shaped spines over the whole surface, similar to *Entocannula hirsuta* (Pl. 99, fig. 20). The keeled margin is armed with numerous long and stout radial spines, which are alternately larger and smaller, as in *Challengeron moseleyi* (Pl. 99, fig. 14); the larger about as long as the radius, the smaller half as long. Peristome with two straight, parallel teeth. Pharnyx funnel-shaped, half as long as the radius, its outer aperture twice as broad as the inner.

*Dimensions.*—Length of the shell 0·24, breadth 0·18; peristome 0·05.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

2. *Porcupinia cordiformis*, n. sp. (Pl. 99, fig. 16).

Shell heart-shaped, nearly triangular, with a deep, concave bosom at the broad oral base, and a bunch of five to nine divergent spines at the blunt aboral apex, the middle spine (in the main axis) larger than the others. Peristome with two parallel, short, triangular teeth, which are obliquely inclined over the mouth (their upper convex edge nearly horizontal). Pharynx cylindrical, short, curved, and obliquely descending.

*Dimensions.*—Diameter of the shell 0·2 to 0·25, of the pharynx 0·05 to 0·08.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

## Family LXXIX. MEDUSETTIDA, n. fam. (Pls. 118–120).

*Definition.*—PHÆODARIA with a simple, ovate, hemispherical or cap-shaped lattice-shell of peculiar alveolate structure, and with hollow articulate feet surrounding the widely open mouth. Central capsule excentric, placed in the aboral half of the shell-cavity.

The family Medusettida represents a peculiar group of remarkable PHÆODARIA, which are similar to the Challengerida and Tuscarorida in the general form of the monaxonian shell and its apophyses, but differ from both families in the strange alveolate structure of the shell and of the hollow articulate feet surrounding its mouth. All the forms of this family here described are new, and not a single species was known before the discoveries of the Challenger. The majority seem to be inhabitants of the deep-sea, and occur mainly in those places where other families of PHÆODARIA (Aulacanthida, Aulosphærida, Cœlodendrida) are also well represented; they are, however, nowhere so common as these latter families. Their long feet and the small delicate

shell are extremely fragile, so that complete and well-preserved specimens are rare. Some species are among the most admirable forms of Radiolaria, and are similar to small elegant Medusæ, *e.g.*, *Medusetta* (Pl. 120, figs. 1–4), *Gazelletta* (Pl. 118, fig. 1), and *Gorgonetta* (Pl. 119).

The shell of the Medusettida is usually very small and delicate, in comparison to the long, often exceedingly large, feet, which depend from the margin of its mouth. From the size and the weight of these feet, we must suppose that the shell floats in the water in the same position as in the NASSELLARIA, so that the main axis is vertical, and the open mouth with the feet on its lower pole. The form of the shell exhibits the same varieties as the similar umbrella of the Medusæ. It is usually more or less hemispherical, sometimes flatter, cap-shaped, at other times more highly vaulted, campanulate or ovate. The similarity with the umbrella of a Medusa is so great, that in many species the large lower opening on the mouth of the shell is surrounded by a prominent ring or diaphragm, comparable to the velum of the Craspedotæ or Hydromedusæ (Pl. 120, figs. 3–4).

The structure of the shell, which we term shortly "alveolate," is very remarkable, and seems to be different from that of all the other PHÆODARIA. Its reticulate appearance seems to indicate at first sight the usual lattice-shell, pierced by numerous very small pores (Pl. 118, figs. 1–3). But as soon as we make the shell dry, air always enters into its thin walls, and each apparent pore is found to be a small alveole or a separate compartment, which contains a small bubble of air (Pl. 120, figs. 11, 16). The thin wall of the shell is therefore double, composed of two parallel, very thin lamellæ of silica, which are little distant from one another, and are connected by a network of small rods or septa. This network is rarely regular, with square meshes (Pl. 118, fig. 3), or with hexagonal or triangular meshes (Pl. 116, fig. 2); it is usually irregular, with polygonal meshes (Pl. 120, figs. 11–16). The size of the meshes or alveoles is usually smallest on the aboral apex of the shell, and increases gradually towards the mouth. The largest alveoles are around the mouth, on the velum-shaped peristome, and here the marginal alveoles of the shell pass directly over into the separate alveoles or hollow compartments of the articulate feet (Pl. 118, fig. 1). Probably each alveole is a separate compartment, filled up by jelly, and has a small opening or pore on its inside; this pore is very distinct in the marginal alveoles of some larger species (Pl. 116, fig. 1*a*; Pl. 120, fig. 14), but I have not been able to recognise it everywhere. Moreover, it often happens that the alveoles are apparently completely closed. In some smaller species the alveolate structure seems to be present only in the peripheral part of the shell, whilst the central part is solid.

The outer convex surface of the shell is usually smooth, sometimes papillate (Pl. 116, fig. 1), at other times studded with small, conical, radial spines (Pl. 118, fig. 1; Pl. 120, figs. 4–11). Prolonged cylindrical spines or tubes are rarely

scattered over the surface (Pl. 116, figs. 1, 2). In some genera a long vertical or oblique spine is developed from the apex of the shell, and is comparable to the "apical horn of the NASSELLARIA (Pl. 118, figs. 2, 3; Pl. 120, figs. 1–4).

The mouth of the shell, or the large opening on the lower pole of its vertical main axis, is usually widely open, circular, or polygonal, more rarely constricted. In many species the peristome is broadened and its margin developed in the form of a horizontal diaphragm, which constricts the entrance into the shell-cavity, and is comparable to the velum of the Hydromedusæ (Pl. 120, figs. 1–4). Sometimes the margin of the velum is fringed and bears numerous small dependent filaments of silica, comparable to the marginal tentacles of many Medusæ (Pl. 118, figs. 1, 3; Pl. 120, fig. 16). Rarely the mouth is strongly constricted and prolonged into a narrow, long, cylindrical tube, comparable to a proboscis; its opening is usually fringed (Pl. 116, figs. 1, 2).

The hollow articulate feet, or the large radial apophyses of the peristome, are the most remarkable organs of the Medusettida, and occur in the same form in no other family of Radiolaria. Their number is variable, from three to twelve or more, and is here employed for the distinction of genera, as it is rather constant; the most frequent number is four (*Medusetta*) or six (*Gazelletta*). The feet are usually cylindrical, much longer than the shell, and more or less curved; more rarely they are straight or slightly compressed. They are always articulate, and divided by numerous transverse parallel septa into hollow compartments or alveoles; the transversely striated appearance of the feet is brought about by these septa. The alveoles have usually the form of short discoidal cylinders, and are broader than long (Pl. 120, figs. 5–13); rarely they are longer than broad (fig. 15). The septa between the alveoles are always perforated by a small opening, and usually this opening is prolonged into a shorter or longer tubule, comparable to the siphuncle in the septa of the chambered shells of Cephalopoda; as in these latter, the succeeding siphons are arranged in a continuous series, which lies either in the axis of the foot or parallel to it (Pl. 120, figs. 8, 13, 15). The siphons are directed towards the distal end of the foot, so that, *e.g.*, the siphon which arises from the septum between the ninth and tenth alveole, projects into the cavity of the latter. The communicating cavities of all the alveoles are filled up by jelly. In the dry shells, which are cleaned by hot mineral acids or by fire, and in which, therefore, the jelly is destroyed, the cavities become easily filled by air-bubbles (Pl. 120, figs. 8, 11, 15). Whilst the alveoles of each foot always form a long simple series, this series becomes doubled on the base of the larger feet, where they are broadened, and pass over into the compartments of the peristome (Pl. 122, figs. 10, 11, 14). The terminal alveole of each foot is closed.

The feet of the Medusettida are rarely quite simple and smooth (Pl. 120, figs. 1, 5, 7, 10, &c.). Usually they are armed with numerous spines or with elegant pencils of spathillæ. These secondary appendages or branches are also hollow, with a

thin wall of silex; but they seem usually not to communicate with the alveoles of the foot directly; the cavities of the foot and its appendages are separated by a thin, solid septum. In *Medusetta* the convex outer edge of each curved foot is studded with a series of simple alveolate branches (Pl. 120, figs. 2–4). In *Gazelletta*, the feet are usually armed with verticillate or alternate spines, which are either simple or branched (Pl. 120, figs. 11–15); sometimes each branch is elegantly arborescent (Pl. 118, fig. 1). Sometimes the distal end of each branch is armed with a spathilla or a coronet of recurved teeth. The branches attain their highest development in the admirable *Gorgonetta* (Pl. 119). The twelve feet of this most interesting genus are differentiated into two different and alternating groups, six descending and six ascending. The six upper or ascending feet are arborescent, and each branch is armed at the distal end with a spathilla (figs. 1, 2). The six lower or descending feet are covered with most elegant arborescent pencils or anchor-bearing trees; each terminal branch of a tree is armed with two spathillæ, a smaller terminal and a larger below it (figs. 3, 4). The distal ends of the feet are rarely simple, usually they are forked or branched, or armed with peculiar spathillæ; and sometimes these terminal branches are very large (Pls. 118, 119).

The *central capsule* of the Medusettida is usually subspherical or somewhat lenticular, and hidden in the aboral or upper part of the shell-cavity, whilst its oral or lower part is filled up by the phæodium (Pl. 120, figs. 2, 9, 10, 11). Sometimes the phæodium is very large and prominent at the aperture of the mouth (Pl. 118, figs. 2, 3; Pl. 119, fig. 1). The nucleus is usually ellipsoidal, half as large as the central capsule, and includes numerous nucleoli. The membrane of the central capsule seems in all Medusettida to possess only one opening, the astropyle or main-opening, with a radiate operculum and proboscis, placed at the lower or oral pole (Pl. 120, fig. 2). I have never been able to observe any secondary opening or parapyle. The free space between the shell-wall and the capsule is filled up by the calymma, which also includes the phæodium. The jelly of the calymma is probably in direct continuity with the jelly which fills up the alveoles of the shell-wall and of the articulate feet.

*Synopsis of the Genera of Medusettida.*

| | | |
|---|---|---|
| I. Subfamily Euphysettida. Peristome of the shell with a corona of three or four feet. Apex of the shell (usually) with an apical horn. | Three equal feet, | 699. *Cortinetta.* |
| | Four equal feet, | 700. *Medusetta.* |
| | One large and three small feet, | 701. *Euphysetta.* |
| II. Subfamily Gazellettida. Peristome of the shell with six to twelve or more feet. Apex of the shell (usually) without apical horn. | Six descending feet, | 702. *Gazelletta.* |
| | Six descending and six ascending alternating feet, | 703. *Gorgonetta.* |
| | Numerous (ten to twenty or more) descending feet, | 704. *Polypetta.* |

Genus 699. *Cortinetta*,[1] n. gen.

*Definition.*—Medusettida with three articulate feet on the peristome.

The genus *Cortinetta* comprises those Medusettida which exhibit the minimum number of feet, three, and which therefore may be compared to the tripodal NASSELLARIA (*Cortina, Cortiniscus, Tripodiscus*, &c.). This similarity is the greater, as in the few observed species an apical horn is developed (as also in the following genus). The three feet are in the two species observed of equal size and similar form, and equidistant, so that they cannot be distinguished as an odd caudal and two paired lateral feet, as in the similar NASSELLARIA.

1. *Cortinetta tripodiscus*, n. sp. (Pl. **117**, fig. 7).

Shell campanulate, covered with numerous curved ascending bristles, with a prominent annular velum on the peristome, similar to that of *Medusetta craspedota* (Pl. **120**, fig. 4). Feet equal, widely divergent and equidistant, somewhat longer than the shell, slightly curved, and covered on their convex outer edge with a series of short lateral branches, the three ramules of which bear a spathilla. Apical horn conical, straight, about as long as the shell, also covered with curved bristles.

*Dimensions.*—Length of the shell 0·14, breadth 0·11; length of the feet 0·16, of the apical horn 0·11.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

2. *Cortinetta cortiniscus*, n. sp.

Shell campanulate, subspherical, thorny, with a prominent annular velum on the peristome. Feet equal, very large, widely divergent, about three times as long as the shell and studded with arborescent branches, similar to those of *Gazelletta drymonema* (Pl. **118**, fig. 1). Apical horn slender, conical, straight, thorny, twice as long as the shell.

*Dimensions.*—Length of the shell 0·18, breadth 0·16; length of the feet 0·5 to 0·6, of the apical horn 0·33.

*Habitat.*—Central Pacific, Station 274, depth 2750 fathoms.

Genus 700. *Medusetta*,[2] n. gen.

*Definition.*—Medusettida with four equidistant articulate feet of equal size on the peristome.

The genus *Medusetta* comprises those forms of the family which bear on the peristome four equal radial feet, and therefore exhibit a striking similarity to many

[1] *Cortinetta*=Diminutive of *Cortina*.

[2] *Medusetta*=Small Medusa.

small Medusæ (*e.g.*, *Codonium*, *Tiara*, *Sarsia*, &c.). This similarity is the greater, as usually the four feet are elegantly curved and the entrance in the shell-cavity partly closed by a marginal diaphragm, comparable to the velum of the Craspedotæ or Hydromedusæ. In all the species observed the apex of the shell bears a slender vertical or curved spine, comparable to the apical horn of the NASSELLARIA. In most species the feet bear on their convex outside a series of teeth or branches, which are also alveolate.

1. *Medusetta codonium*, n. sp. (Pl. 120, fig. 1).

Shell ovate, smooth, twice as broad as the constricted mouth. Apical horn about as long as the shell, nearly straight, smooth. Feet cylindrical, smooth, irregularly curved, about as long as the shell.

*Dimensions.*—Length of the shell 0·08, breadth 0·05.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

2. *Medusetta tiara*, n. sp.

Shell campanulate, smooth, about as long as broad, and three times as broad as the constricted mouth, which is surrounded by a horizontal broad ring, like the velum of a Hydromedusa. Apical horn conical, straight, half as long as the shell. Feet divergent, irregularly curved, twice as long as the shell.

*Dimensions.*—Length of the shell 0·07, breadth 0·06.

*Habitat.*—North Atlantic (Færöe Channel), John Murray, surface.

3. *Medusetta minima*, n. sp.

Shell slenderly ovate, smooth, about twice as long as broad, twice as broad as the constricted mouth. Apical horn straight, vertical, of the same length. Feet somewhat longer, very thin, slightly curved at the base, in the distal half nearly parallel and descending vertically.

*Dimensions.*—Length of the shell 0·06, breadth 0·03.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

4. *Medusetta quadrigata*, n. sp. (Pl. 120, fig. 2).

Shell ovate, campanulate, smooth, little broader than the wide open mouth. Apical horn longer than the shell, more or less curved, smooth. Feet cylindrical, about as long as the shell, strongly curved and somewhat spirally revoluted, with a series of short curved teeth on the abaxial margin.

*Dimensions.*—Length of the shell 0·07 to 0·09, breadth 0·04 to 0·06.

*Habitat.*—North Pacific (off Japan), Stations 231 to 237, surface.

5. *Medusetta tetranema*, n. sp. (Pl. 120, fig. 3).

Shell campanulate, conical, smooth, nearly twice as broad as the constricted mouth, without prominent velum. Apical horn somewhat shorter, straight, conical, thorny. Feet strongly curved inwards, convergent, twice as long as the shell, each with four to six strong, ascending, alveolate branches on the abaxial margin.

*Dimensions.*—Length of the shell 0·07 to 0·09, breadth 0·05 to 0·07.

*Habitat.*—Tropical Atlantic, Station 352, surface.

6. *Medusetta spiralis*, n. sp.

Shell hemispherical, thorny, with wide open mouth. Apical horn straight, vertical, thorny, twice as long as the shell; feet cylindrical, three times as long as the shell, spirally convoluted around the vertical axis of the shell, with a series of recurved teeth on the abaxial margin.

*Dimensions.*—Length of the shell 0·05, breadth 0·08.

*Habitat.*—Central Pacific, Stations 271 to 272, surface.

7. *Medusetta craspedota*, n sp (Pl. 120, fig. 4).

Shell campanulate or nearly spherical, spiny, twice as broad as the constricted mouth, which is surrounded by a funnel-shaped truncate velum. Apical horn conical, straight, spiny, half as long as the shell. Feet strongly curved, longer than the shell, with a series of short conical spines on the abaxial side.

*Dimensions.*—Length of the shell 0·06, breadth 0·06.

*Habitat.*—North Pacific, Station 239, surface.

## Genus 701. *Euphysetta*,[1] n. gen.

*Definition.*—Medusettida with four articulate feet on the peristome, one odd very large, and three small or rudimentary feet.

The genus *Euphysetta* agrees with the preceding *Medusetta* in the possession of four articulate feet; but whilst these in the latter are of equal size and similar shape, in the former a single odd foot only is developed, and very large, whilst the three others are rudimentary and very small. *Euphysetta* exhibits therefore the same relation to *Medusetta* that the Euphysidæ (*Euphysa*, *Steenstrupia*, &c.) bear to the Sarsiadæ (*Codonium*, *Sarsia*), among the Hydromedusæ (compare my System der Medusen, 1879, vol. i. p. 12).

[1] *Euphysetta* = Diminutive of *Euphysa* (a Medusa).

1. *Euphysetta staurocodon*, n. sp. (Pl. 118, fig. 2).

Shell ovate, nearly as broad as long, smooth, with an oblique, slender, conical, apical horn of the same length. The larger odd foot cylindrical, curved, somewhat longer than the shell, with three diverging branches at the distal end. The three smaller feet very short, representing the form of a regular rectangular cross.

*Dimensions.*—Length of the shell 0·15, breadth 0·14.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

2. *Euphysetta hybocodon*, n. sp.

Shell ovate, one and one-third times as long as broad, smooth, with an oblique, stout, conical horn of half the length. The larger odd foot cylindrical, curved, twice as long as the shell, with a few pairs of short lateral branches and forked distal end. The three smaller feet half as long as the shell, thorny.

*Dimensions.*—Length of the shell 0·16, breadth 0·12.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

3. *Euphysetta amphicodon*, n. sp. (Pl. 118, fig. 3).

Shell subspherical, smooth, with a short, oblique, conical, apical horn. The larger odd foot cylindrical, nearly straight, as long as the shell, with a few short lateral branches, at the distal end forked. The three smaller feet were in one specimen observed forked, in another (the specimen figured) replaced by nine small thorns.

*Dimensions.*—Length of the shell 0·11, breadth 0·13.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

## Genus 702. *Gazelletta*,[1] John Murray, 1876 (*in litteris*).

*Definition.*—Medusettida with six articulate feet on the peristome.

The genus *Gazelletta* is by far the most common of all Medusettida, and some species seem to be widely distributed, or even cosmopolitan. The number of species, too, is in this genus much larger than in all the other genera of this family. It differs from the latter in the possession of six feet, which number is very constant in the majority of species; in some species, however, single specimens are not rarely found which possess five or seven feet instead of six. Usually the six feet are rather regularly formed and disposed, and diverge downwards; but sometimes there is more or less

[1] *Gazelletta* = Named in memory of the German ship "Gazelle," which was engaged in deep-sea soundings during the years 1874 to 1876, under the command of Captain Schleinitz (Naturalist, Professor Studer).

irregularity in their shape and arrangement. In the majority of species the feet are very long, curved, and armed in a very various manner, so that four subgenera may be distinguished, according to the armatures.

### Subgenus 1. *Gazellarium*, Haeckel.

*Definition.*—Feet simple, smooth, without spines and without terminal branches.

1. *Gazelletta hexanema*, n. sp. (Pl. 120, fig. 5).

Shell hemispherical, smooth. Feet very long, cylindrical, straight, smooth, widely divergent, without terminal branches.

*Dimensions.*—Length of the shell 0·03 to 0·04, breadth 0·06 to 0·07; length of the feet 0·1 to 0·2.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific, surface.

2. *Gazelletta macronema*, n. sp. (Pl. 120, figs. 7, 8).

Shell hemispherical, smooth. Feet very long, cylindrical, smooth, in the basal part horizontally expanded, in the distal part strongly curved downwards, without terminal branches.

*Dimensions.*—Diameter of the shell 0·1 to 0·12, length of the feet 1·2 to 1·6.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

3. *Gazelletta orthonema*, n. sp. (Pl. 120, fig. 10).

Shell hat-shaped, thorny. Feet cylindrical, straight, smooth, widely divergent, without terminal branches.

*Dimensions.*—Diameter of the shell 0·12 to 0·16, length of the feet 0·3 to 0·5.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

4. *Gazelletta cyrtonema*, n. sp. (Pl. 120, fig. 9).

Shell hat-shaped, thorny. Feet cylindrical, smooth, widely diverging at the base, strongly curved and convergent in the distal part, often semicircular, without terminal branches.

*Dimensions.*—Diameter of the shell 0·11 to 0·13, length of the feet 0·4 to 0·6.

*Habitat.*—North Atlantic, Station 354, Canary Islands, surface.

### Subgenus 2. *Gazellidium*, Haeckel.

*Definition.*—Feet smooth, without lateral spines, but branched at the distal end, or with a bunch of terminal spines.

5. *Gazelletta furcata*, n. sp.

Shell flat, cap-shaped, smooth. Feet cylindrical, nearly straight, at the distal end forked, with two divergent, spinulate, terminal branches.

*Dimensions.*—Length of the shell 0·12, breadth 0·3; length of the feet 0·6 to 0·8.

*Habitat.*—Western Tropical Pacific, Station 224, surface.

6. *Gazelletta bifurca*, n. sp. (Pl. 120, fig. 6).

Shell cap-shaped, thorny. Feet nearly straight, widely divergent, cylindrical, smooth, at the distal end twice forked, with four divergent, terminal branches, each of which bears a spathillum with six to eight recurved teeth (sometimes, as in the specimen figured, five or six terminal branches instead of four).

*Dimensions.*—Diameter of the shell 0·1, length of the feet 0·3 to 0·4.

*Habitat.*—South Pacific, Station 288, surface.

7. *Gazelletta penicillata*, n. sp.

Shell campanulate, spiny. Feet cylindrical, strongly curved, smooth, with a bunch of twelve to twenty or more curved spines at the distal end.

*Dimensions.*—Diameter of the shell 0·08, length of the feet 0·6.

*Habitat.*—Central Pacific, Station 266, surface.

## Subgenus 3. *Gazellonium*, Haeckel.

*Definition.*—Feet spiny, armed with simple or branched lateral spines, and with terminal branches of the same shape.

8. *Gazelletta pectinata*, n. sp.

Shell flat, cap-shaped, thorny, three times as broad as high. Feet straight or slightly curved, cylindrical, widely divergent, with four longitudinal rows of short and simple conical spines, which are directed towards the distal end, and about as long as a single joint of the foot.

*Dimensions.*—Length of the shell 0·16, breadth 0·5; length of the feet 1·5 to 2·0, breadth 0·03 to 0·05.

*Habitat.*—North Atlantic, Færöe Channel (John Murray), Hebrides (Mœbius).

9. *Gazelletta pinnata*, n. sp.

Shell hat-shaped, thorny. Feet cylindrical, strongly curved, pinnate, with two opposite longitudinal rows of simple conical spines, which are slightly curved, directed towards the distal end and opposed in pairs on about each third or fourth joint.

*Dimensions.*—Diameter of the shell 0·3, length of the feet 1·2 to 1·5.

*Habitat.*—South Atlantic, Station 325, depth 2650 fathoms.

10. *Gazelletta studeri*, n. sp. (Pl. 120, fig. 15).

Shell flat, cap-shaped, thorny. Feet widely divergent, nearly straight and horizontally expanded, with two alternate longitudinal rows of lateral spines, which arise perpendicularly from the foot, are simple, conical, slightly curved, and alternate on the succeeding joints. Ends of the feet constricted, with four to six spines in one row. Dedicated to Professor Studer.

*Dimensions.*—Diameter of the shell 0·15, length of the feet 0·6 to 0·8.

*Habitat.*—South Atlantic (east of Patagonia), Station 318, surface.

11. *Gazelletta schleinitzii*, n. sp. (Pl. 120, figs. 11, 12).

Shell hat-shaped, thorny. Feet cylindrical, nearly straight and horizontally expanded, with four longitudinal rows of equal lateral spines, which arise perpendicularly from the foot and bear at the end three short divergent teeth. The end of the arms bears three forked spines. I name this elegant species in honour of Captain Schleinitz, commander of the German ship "Gazelle," who conducted the deep-sea soundings during the years 1874 to 1876.

*Dimensions.*—Diameter of the shell 0·12, length of the feet 0·6 to 0·8.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

12. *Gazelletta trispathilla*, n. sp. (Pl. 120, fig. 13).

Shell flat, cap-shaped, smooth. Feet cylindrical, nearly straight, widely divergent, with longitudinal rows of alternate spines, which arise perpendicularly from the foot and bear at the end three short divergent branches, each with a spathilla of six short teeth.

*Dimensions.*—Diameter of the shell 0·2 to 0·25, length of the feet 1·2 to 1·5.

*Habitat.*—North Pacific, Station 235 to 238, surface.

13. *Gazelletta robusta*, n. sp. (Pl. 120, fig. 14).

Shell flat, cap-shaped, thorny. Feet cylindrical, very stout, slightly curved, covered with short irregularly branched spines; their ends with a bunch of similar spines.

*Dimensions.*—Diameter of the shell 0·6, length of the feet 2·5 to 3·3.

*Habitat.*—Central Pacific, Stations 263 to 274, surface.

## Subgenus 4. *Gazellusium*, Haeckel.

*Definition.*—Feet spiny, armed with simple or branched lateral spines, and with larger terminal branches of a different shape.

14. *Gazelletta dendronema*, n. sp. (Pl. 120, fig. 16).

Shell hemispherical, thorny, with a broad, alveolate velum which bears irregular hollow thorns on the inside and on the free margin (fig. 16). Feet divergent, irregularly curved, with scattered arborescent lateral spines, which are irregularly branched, and bear at the distal end of each branch a small spathilla with four to six teeth. The distal ends of the feet are dichotomously branched, with stouter simple fork-branches.

*Dimensions.*—Length of the shell 0·17, breadth 0·36; length of the feet 0·5 to 0·7.

*Habitat.*—North Pacific, Station 252, surface.

15. *Gazelletta melusina*, n. sp. (Pl. 118, fig. 1).

Shell campanulate, spiny. Feet divergent, strongly curved, with scattered arborescent lateral spines, which are richly and dichotomously branched, with thin, simple, terminal branches. The distal ends of the feet bear three or four much larger and stouter branches, which are again dichotomously branched.

*Dimensions.*—Length of the shell 0·2, breadth 0·15; length of the feet 0·5 to 0·8.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

## Genus 703. *Gorgonetta*,[1] n. gen.

*Definition.*—Medusettida with twelve articulate feet on the peristome, six ascending and six alternate descending.

The genus *Gorgonetta* is the most highly developed of all hitherto observed Medusettida, and belongs to the most remarkable forms of Radiolaria. Its general shape is very similar to that of a larva of a *Geryonia* or *Carmarina*, in which six interradial larval tentacles are directed upwards, six alternating perradial permanent tentacles downwards. The six ascending feet are in all the four species observed smaller, more or less branched, and armed with spathillæ. The six descending feet are much larger and covered with very elegant pencils, the single threads of which bear a double spathilla. The distal ends of the feet are forked or branched.

1. *Gorgonetta mirabilis*, n. sp. (Pl. 119, figs. 1–4).

Shell cap-shaped, flatly vaulted, or nearly hemispherical, about twice as broad as long, with smooth surface. Six ascending feet widely divergent, about twice as long as the breadth of the shell, nearly straight, arborescent, with numerous curved branches, each of which bears at the distal end a spathilla with four to six short recurved teeth (fig. 2). Six descending feet about twice as

[1] *Gorgonetta*=Diminutive of *Gorgo*, Medusa.

long as the six alternate ascending, nearly straight, covered with numerous elegant pencils. Each pencil is richly branched, with fifty to one hundred or more thread-like ramules, and each terminal ramule has two cruciate spathillæ, a larger proximal and a smaller distal (figs. 3, 4); the four recurved anchor-teeth of the proximal spathilla are twice as large as those of the distal. The distal end of each descending foot bears three or four very stout terminal branches, each of which is about as long as the shell and again trifurcate at the distal end.

*Dimensions.*—Length of the shell 0·2 to 0·3, breadth 0·4 to 0·5.

*Habitat.*—Tropical Atlantic, Stations 346 to 348, surface.

2. *Gorgonetta geryonia*, n. sp.

Shell hemispherical, twice as broad as long, with short scattered thorns on the surface. Twelve feet of similar shape to those in the preceding species, but differing in the following characters:—the six ascending feet are much smaller, about as long as the breadth of the shell, and each bears only six to twelve short branches; the six descending feet are about three times as long as the shell, more or less curved; their pencils much smaller, and the two spathillæ of each pencil-thread bear five anchor-teeth. The distal ends are more richly and irregularly branched.

*Dimensions.*—Length of the shell 0·4, breadth 0·7.

*Habitat.*—Indian Ocean (Cocos Islands), Rabbe, surface.

3. *Gorgonetta carmarina*, n. sp.

Shell flat, cap-shaped, three times as broad as long. Twelve feet similar in shape to those of the two preceding species, but more irregular in form and arrangement, and differing in the following characters:—the six ascending feet are nearly horizontally expanded, one and a half times as long as the breadth of the shell, with few short branches, each of which bears a spathilla with six recurved anchor-teeth. The six descending feet are about five times as long as the shell, irregularly curved, studded with numerous small pencils, each thread of which bears a double spathilla with six teeth. The distal ends are irregularly branched.

*Dimensions.*—Length of the shell 0·2, breadth 0·7.

*Habitat.*—South Pacific, Station 318, depth 2040 fathoms.

4. *Gorgonetta bisenaria*, n. sp.

Shell campanulate, similar to that of *Gazelletta melusina* (Pl. **118**, fig. 1), with smooth surface. Six ascending feet about as long as the shell, nearly straight, similar to those of *Gorgonetta mirabilis* (Pl. **119**, fig. 1). Six descending feet also similar to those of the latter, but shorter, about twice as long as the shell, strongly curved, studded with numerous small pencils, each thread of which has a double spathilla with three teeth. The distal end of each foot bears a whorl of six to eight irregular forked branches.

*Dimensions.*—Length of the shell 0·5, breadth 0·4.

*Habitat.*—Central Pacific, Station 263, surface.

## Genus 704. *Polypetta*,[1] n. gen.

*Definition.*—Medusettida with numerous (ten to twenty or more) articulate feet.

The genus *Polypetta* comprises those Medusettida in which the number of feet is very large and not limited, usually twenty to thirty or more. The few specimens of this genus that have been observed are rather different; and it may be that only the two first species described in the following lines are true Medusettida; they possess the usual distinctly alveolate feet, and are derived from the similar *Medusetta* or *Gazelletta* simply by multiplication of the feet. The two other species, however (figured in Pl. 116, figs. 1, 2, as *Porospathis*), belong perhaps to another family of PHÆODARIA (Castanellida?); their shell-structure is peculiar and their feet not distinctly alveolate; they may therefore represent a peculiar genus *Porospathis* (Haeckel, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, 1879, p. 5).

### 1. *Polypetta polynema*, n. sp.

Shell campanulate, thorny, about as long as broad, with slightly constricted mouth, similar to that of *Gazelletta orthonema* (Pl. 120, fig. 10). Shell-wall hollow, with irregular polygonal alveoles. Peristome with a corona of eighteen divergent, curved, cylindrical feet of unequal size; six larger primary on the margin of the shell, the other twelve secondary, between the former, somewhat above the margins at different heights. The feet are two to three times as long as the shell, irregularly curved and distinctly alveolate, without appendages.

*Dimensions.*—Length of the shell 0·12, breadth 0·11.

*Habitat.*—Central Pacific, Station 266, surface.

### 2. *Polypetta alveolata*, n. sp.

Shell campanulate, thorny, about as long as broad, very similar to that of *Medusetta craspedota* (Pl. 120, fig. 4). Shell-wall hollow, with subregular hexagonal alveoles. Peristome prolonged into a short funnel-shaped proboscis, twice as long as the similar velum of the latter. The velum is surrounded by a corona of eight larger and eight to twelve smaller feet; the larger are about as long as the shell, divergent, irregularly curved, thorny, and distinctly alveolate; the smaller feet are scattered above the latter and form an immediate transition to the small spines of the shell-surface.

*Dimensions.*—Length of the shell 0·08, breadth 0·09.

*Habitat.*—South Pacific, Station 284, surface.

[1] *Polypetta* = Diminutive of *Polypus*.

3. *Polypetta tabulata*, n. sp. (Pl. 116, figs. 2, 2*a*, 2*b*).

*Porospathis tabulata*, Hæckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12.

Shell subspherical, with elegantly panelled or tabulate surface, composed of small triangular plates, which are separated by a network of prominent crests; at each nodal point of the network a small conical thorn arises (figs. 2*a*, 2*b*). Each triangular plate seems to contain a hollow alveole, which opens into the shell-cavity (?). On the surface of the shell are scattered numerous (thirty to forty or more), cylindrical, hollow, radial spines, which are straight or slightly curved, not distinctly alveolate, and increase in size towards the mouth. The aboral spines are scarcely one-third as long as the radius of the shell, whilst the oral spines are three times as long as its diameter. The proboscis of the constricted mouth is a hollow cylinder, longer than the shell-radius, and armed with a corona of fifteen to twenty slender bristle-shaped teeth. The position of this singular species in this family is doubtful.

*Dimensions.*—Diameter of the shell 0·1 to 0·11, length of the peristome 0·07, breadth 0·02.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

4. *Polypetta mammillata*, n. sp. (Pl. 116, figs. 1, 1*a*).

*Porospathis mammillata*, Hæckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12.

Shell subspherical, densely covered with numerous mammiliform hollow papillæ, between which are scattered single longer, hollow, radial spines; these are irregularly curved, cylindrical, without distinct alveoles; the twelve longest are two to three times as long as the shell, divergent in the oral direction, and surround the base of the peristome in two irregular alternate circles, each with six spines. The hollow papillæ of the surface, between which are placed numerous circular pores (or dimples ?), open into the shell-cavity by a small pore (fig. 1*a*); they are perhaps reduced radial spines. The constricted peristome is conical and prolonged into an inversely conical proboscis, which is about as long as the radius of the shell; its dilated mouth is surrounded by a corona of slender, divergent, bristle-shaped teeth. The position of this species in the family Medusettida is doubtful; perhaps it is more closely allied to the Castanellida.

*Dimensions.*—Diameter of the shell 0·12; length of the proboscis 0·08, breadth 0·03; length of the shorter spines 0·1, of the longest spines 0·3.

*Habitat.*—North Pacific, Station 252, surface.

## Family LXXX. CASTANELLIDA, Haeckel, 1879 (Pl. 113).

*Castanellida*, Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—PHÆODARIA with a spherical or subspherical shell, exhibiting ordinary lattice-work, with circular or roundish pores. Radial spines without circles of basal pores. Mouth of the shell large, usually circular and armed with teeth. Central capsule excentric, placed in the aboral half of the shell-cavity.

The family Castanellida represents a common and widely distributed group of PHÆODARIA, which possess a very simple and uniform shell, viz., a simple lattice-sphere with radial spines and one simple mouth. It may therefore be easily confounded with the Coscinommida, or those Sphæroidea in which the shell is also a simple lattice-sphere armed with radial spines (*Astrosphærida simplicia*, p. 209). Indeed the shell of both groups is very similar, and differs in one important point only; the Castanellida constantly possess one larger opening in the shell-wall, the shell-mouth, which is either smooth or armed with a corona of teeth; in the Coscinommida, however, such a mouth is never present. The living specimens of both groups, and those shells in which the soft body is preserved, are very easily distinguished, since the shell encloses in the Coscinommida the central capsule and the transparent calymma only, whilst the latter, besides, in the Castanellida contains a voluminous dark brown or green mass of phæodella, the characteristic phæodium. A closer examination of the central capsule reveals in all Castanellida the typical operculum, the astropyle, with the proboscis of the PHÆODARIA, which is never present in any Sphæroidea.

The Castanellida are easily distinguished also from those similar PHÆODARIA in which the shell is also a lattice-sphere; the lattice-work is constantly quite simple, as in the similar Coscinommida, never composed of separated tangential pieces (as in the Aulosphærida), or of porcellanous structure, with basal circles of pores (as in the Circoporida), or of diatomaceous structure (as in the Challengerida). The gigantic Orosphærida, which also in part possess a simple lattice-sphere, differ from the Castanellida in the absence of the peculiar shell-mouth.

Though the Castanellida belong to the most common PHÆODARIA, and though the number of individuals, floating on the surface of the tropical seas, is extraordinarily great, their variety of forms is very small; the six genera distinguished in the following system differ only in very slight characters, and the majority of the species are very similar, and often hardly distinguishable. The seven species figured in Pl. 113 exhibit the most striking differences which I could distinguish among all the species observed. The shell usually has the characteristic appearance of a chestnut, a sphere covered with very numerous short radial spines or bristles. In the majority of species a certain number of longer thin radial spines is scattered over the surface; these are usually simple, rarely branched. The mouth of the shell, corresponding to the proboscis of the central capsule, and placed in the same radius, is either a quite simple larger opening with a smooth margin (figs. 3, 5, 7) or is armed with a corona of teeth (figs. 1, 6).

The size of the shell varies between 0·2 and 0·8 mm., and is usually between 0·3 and 0·5 mm. Its form is in the majority of species a geometrical sphere; rarely it is somewhat irregular, slightly ellipsoidal (prolonged in the axis of the mouth and proboscis), or polyhedral (by conical protuberances from the bases of the radial spines).

The ideal fundamental form of the shell, however, is constantly monaxonian, since the place of the shell-mouth and of the proboscis of the capsule (both lying in one axis of the sphere), causes a principal axis to be different from all others. The longer radial spines, quite variable in number and disposition, are never arranged regularly or symmetrically, and therefore determine no constant axes.

The lattice-work of the spherical shell offers also but slight differences. It is usually more or less irregular, with circular or subcircular pores of unequal sizes. More rarely the network is perfectly regular, with equidistant circular pores of equal size, and sometimes these are surrounded by hexagonal frames (fig. 6), as in many Sphæroidea. More rarely the pores are perfectly irregular, roundish or sometimes polygonal, of unequal sizes and dissimilar forms (fig. 2). The size of the pores is very variable, between 0·01 and 0·05, usually between 0·015 and 0·025. They are commonly somewhat broader than the bars between them, more rarely smaller. The substance of the shell-wall is in the majority of Castanellida hyaline, transparent (as in the similar Sphæroidea); in some larger forms, however, a network of fine axial filaments is visible in the lattice (fig. 2), and sometimes this seems to be hollow, with an axial canal (as in the large Orosphærida). Such an axial filament or fine axial canal is usually visible in the larger radial spines. The shell-wall of the Castanellida, however, never exhibits that characteristic structure (with tangential needles in a cement-like fundamental substance), which we find in all Circoporida. The latter differ also in the constant presence of circles of large pores around the bases of the radial spines, which are never found in the Castanellida. The shell becomes usually stained more or less purple by carmine, and when burned by fire, becomes of a brown colour.

The inner surface of the shell is always quite smooth, the outer surface armed with numerous short and thin radial bristles. Sometimes these bristles or "by-spines" are very short, but never perfectly wanting. Usually their length is about one-third or one-fourth of the radius of the shell, often less, rarely more. They arise from the nodal points between every three or four neighbouring spines, and are commonly very thin and straight, pointed, with slightly thickened conical basis. Rarely they are directed not quite radially, but more or less obliquely.

The larger radial spines, which arise between the thin bristles or "by-spines" and may be opposed to the latter as "main-spines," are wanting in two genera only, in *Castanarium* and *Castanella* (Pl. 113, fig. 6). They are simple in *Castanidium* (figs. 2, 5, 7) and *Castanissa* (fig. 1), irregularly branched in *Castanopsis* and *Castanura* (figs. 3, 4). Their number and disposition is never regular nor symmetrical (as in the majority of Sphæroidea) and varies even in each single species. In general the number of main-spines varies between ten and forty (rarely less or more) usually between twenty and thirty. Their length is commonly about equal to the diameter of the shell, often somewhat shorter, rarely considerably longer. Their

thickness is in the majority of species about equal to the diameter of one or two pores of the lattice. Sometimes they are much stronger, rarely thinner.

The form of the radial main-spines is not very variable, usually it is cylindrical or cylindro-conical, rarely angular, prismatic or pyramidal. Sometimes they are straight (perfectly radial), at other times more or less irregularly curved. Usually they are simple, rarely branched; the branches are always very irregular and exhibit a remarkable tendency to unite by concrescence (figs. 3, 4). Some thicker forms of spines exhibit a remarkable structure, the surface being covered with small dimples and spinules between them (fig. 1); sometimes the dimples are hexagonal (fig. 5*a*). In the axis of the thicker spines there is often visible the same axial filament or funicle which we find in many other PHÆODARIA, more rarely a hollow axial canal.

The mouth of the shell is usually circular, more rarely polygonal or irregularly roundish (fig. 2). It is either quite smooth (figs. 3, 5, 7) or armed with a corona of strong teeth (figs. 1, 4, 6). These teeth are different from the other spines of the shell; they are much thicker than the radial bristles, and shorter than the main-spines. Their number varies between three and twenty, usually between five and seven. They are usually parallel to the main axis, which is determined by the excentric position of the mouth and the centre of the sphere (figs. 1, 6). The teeth are usually conical, more or less irregular in size and form, more rarely of equal size. The corona of teeth is usually sharply separated from the surrounding lattice-work of the shell, but has no influence on its regular spherical form.

The *central capsule* of the Castanellida immediately determines beyond doubt their true PHÆODARIAN nature; it lies excentrically in the cavity of the enclosing shell, and is surrounded at the oral pole by the large and dark phæodium. The latter covers the radiate operculum of the capsule membrane and the tubular proboscis, which arises from it and is directed towards the shell mouth. Usually the diameter of the spherical central capsule is about one-third of the shell diameter, rarely one-quarter only, and in a few cases it attains nearly its half. The calymma, therefore, is larger than the capsule, and fills up the whole cavity of the shell which is not occupied by the latter. The greater part of the calymma again is filled up by the dark green or brown, sometimes black phæodella, the roundish granules which compose the voluminous non-transparent phæodium. Sometimes the latter proceeds through the mouth and is partially placed outside the shell (fig. 5).

The astropyle, or the main-opening of the central capsule, is placed on the oral pole of its main axis, while its radiate operculum and the tubular proboscis arising from it possess the same structure as in the other PHÆODARIA. But the two lateral parapylæ or accessory openings which are present in the majority of the latter seem to be absent in the Castanellida as well as in the Medusettida and the Challengerida. I could never observe a trace of them. The proboscis is a small cylindrical tube and is directed towards the

mouth of the shell, therefore placed in its main axis; it is usually quite hidden in the dark phæodium, which occupies the oral half of the shell-cavity, whilst the capsule lies in the aboral half. The large nucleus of the central capsule and its double membrane present the same characters as in the other PHÆODARIA.

*Synopsis of the Genera of Castanellida.*

| | | | |
|---|---|---|---|
| No long radial main-spines (in addition to the constant short bristles of the shell-surface). | | Mouth smooth, | 705. *Castanarium.* |
| | | Mouth dentate, | 706. *Castanella.* |
| Long radial main-spines scattered between the short constant bristles of the shell-surface. | Main spines simple. | Mouth smooth, | 707. *Castanidium.* |
| | | Mouth dentate, | 708. *Castanissa.* |
| | Main spines branched. | Mouth smooth, | 709. *Castanopsis.* |
| | | Mouth dentate, | 710. *Castanura.* |

Genus 705. *Castanarium*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Castanellida without radial main-spines, with a simple smooth mouth.

The genus *Castanarium* is the simplest form of all the Castanellida, and may be regarded as the common ancestral form of this family. The simple spherical shell has a smooth, toothless mouth and no larger radial spines; it is densely studded with the simple, radial bristles, which are common to all Castanellida. The shell therefore is very similar to those species of the Astrosphæride *Acanthosphæra*, which represent the subgenus *Rhapidococcus* (compare above, p. 210, Pl. 26, fig. 3); it differs from the latter in the possession of the shell-mouth, which is absent in all Sphæroidea.

1. *Castanarium darwini*, n. sp.

Pores regular, circular, hexagonally framed, three times as broad as the bars. Radial bristles half as long as the radius.

*Dimensions.*—Diameter of the shell 0·3 to 0·4, of the pores 0·03.

*Habitat.*—South Atlantic (east of Patagonia), Station 318, depth 2040 fathoms.

[1] *Castanarium* = Shell similar to a chestnut, *Castanea*.

2. *Castanarium hookeri*, n. sp.

Pores regular, circular, hexagonally framed, twice as broad as the bars. Radial bristles one-third as long as the radius.

*Dimensions.*—Diameter of the shell 0·55, of the pores 0·025.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

3. *Castanarium lyelli*, n. sp.

Pores regular, circular, without hexagonal frames, of the same breadth as the bars. Radial bristles twice as long as the diameter of one pore.

*Dimensions.*—Diameter of the shell 0·24, of the pores 0·015.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

4. *Castanarium lubbocki*, n. sp.

Pores irregularly roundish, about of the same breadth as the roundish, non-crested bars. Radial bristles one-third as long as the radius.

*Dimensions.*—Diameter of the shell 0·36, of the pores 0·01 to 0·02.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

5. *Castanarium huxleyi*, n. sp.

Pores irregularly polygonal, two to three times as broad as the bars, separated by prominent polygonal crests. Radial bristles half as long as the radius.

*Dimensions.*—Diameter of the shell 0·45, of the pores 0·02 to 0·05.

*Habitat.*—South Pacific (off Australia), Station 165, surface.

Genus 706. *Castanella*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Castanellida without radial main-spines, with a dentate mouth.

The genus *Castanella* comprises the most common and most widely distributed species of Castanellida. It agrees in general shape with its ancestral form, the preceding *Castanarium*, differing from it only in the possession of strong teeth, which form a corona around the mouth.

[1] *Castanella* = Diminutive of *Castanea*.

1. *Castanella wyvillei*, n. sp. (Pl. 113, fig. 6).

Pores regular, circular, of equal size, hexagonally framed, of the same breadth as the bars. Radial bristles twice as long as the diameter of one pore. Mouth with five to six parallel, conical strong teeth, which are twice as long as a bristle (fig. 6*a*).

*Dimensions.*—Diameter of the shell 0·5 to 0·7, of the pores 0·02 to 0·03.

*Habitat.*—North Pacific, Stations 252 to 256, surface.

2. *Castanella thomsoni*, n. sp.

Pores regular, circular, of equal size, hexagonally framed, twice as broad as the bars. Radial bristles about as long as the diameter of one pore. Mouth with four strong, conical teeth, forming a regular cross, four times as long as a bristle.

*Dimensions.*—Diameter of the shell 0·7 to 0·8, of the pores 0·03.

*Habitat.*—South Pacific, Stations 295 to 298, surface.

3. *Castanella campbelli*, n. sp.

Pores regular, circular, hexagonally framed, three times as broad as the bars. Radial bristles half as long as the radius of the shell. Mouth with a coronet of eight conical, parallel teeth, of the same length as the bristles, but four to six times as thick.

*Dimensions.*—Diameter of the shell 0·4 to 0·45, of the pores 0·025.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

4. *Castanella sloggetti*, n. sp.

Pores subregular, circular, without frames, of different sizes, about twice as broad as the bars. Radial bristles three times as long as one pore. Mouth with five or six strong, conical teeth, twice as long as the bristles.

*Dimensions.*—Diameter of the shell 0·3 to 0·36, of the pores 0·02 to 0·03.

*Habitat.*—Tropical Atlantic, Stations 347 to 349, surface.

5. *Castanella balfouri*, n. sp.

Pores irregular, roundish, two to three times as broad as the bars. Bristles about one-fourth as long as the radius. Mouth with four strong conical teeth, forming a cross, somewhat longer and much thicker than the bristles.

*Dimensions.*—Diameter of the shell 0·22 to 0·28, of the pores 0·01 to 0·02.

*Habitat.*—North Pacific, Stations 240 to 245, surface.

6. *Castanella channeri*, n. sp.

Pores irregular, roundish, two to four times as broad as the bars. Bristles nearly half as long as the radius. Mouth with seven to nine short conical teeth, shorter than the bristles, but much thicker.

*Dimensions.*—Diameter of the shell 0·3 to 0·4, of the pores 0·02 to 0·025.

*Habitat.*—North Atlantic, Stations 352 to 354, surface.

7. *Castanella horstoni*, n. sp.

Pores irregular, polygonal, three to four times as broad as the bars. Bristles about as long as the radius. Mouth with six stout pyramidal teeth, which are scarcely one-third as long as the radius.

*Dimensions.*—Diameter of the shell 0·55, of the pores 0·02 to 0·025.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

Genus 707. *Castanidium*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Castanellida, with simple radial main-spines and a simple smooth mouth.

The genus *Castanidium* agrees with its ancestral form *Castanarium* in the simple shape of the smooth and toothless mouth, but differs from it in the possession of long radial main-spines, which are scattered between the constant radial bristles or by-spines of the surface. The shell agrees therefore in its general shape with the Astrosphæride *Heliosphæra*, as defined above (p. 217, Pl. 26, fig. 9), but differs from it in the possession of the shell-mouth wanting in all Sphæroidea.

1. *Castanidium willemoesi*, n. sp.

Pores regular, circular, hexagonally framed, twice as broad as the bars. Bristles three times as long as the diameter of one pore. Radial main-spines straight, conical, smooth, as long as the radius.

*Dimensions.*—Diameter of the shell 0·3 to 0·4, of the pores 0·012 to 0·016.

*Habitat.*—Central Pacific, Station 263 to 274, surface.

2. *Castanidium wildi*, n. sp.

Pores regular, circular, hexagonally framed, of the same breadth as the bars. Bristles twice as long as one pore. Radial main-spines straight and short, cylindrical, with dimpled surface (as in Pl. 113, fig. 1), as broad as one pore and as long as the diameter of the shell.

*Dimensions.*—Diameter of the shell 0·66, of the pores 0·045.

*Habitat.*—South Pacific, Station 297, surface.

[1] *Castanidium* = Small chestnut; καστανίδιον.

3. *Castanidium buchanani*, n. sp. (Pl. 113, fig. 7).

Pores regular, circular, without frames, twice as broad as the bars, of variable size. Bristles five to six times as long as one pore. Radial main-spines numerous, straight, slender, cylindrical, about as long as the diameter of the shell.

*Dimensions.*—Diameter of the shell 0·25 to 0·3, of the pores 0·012 to 0·02.

*Habitat.*—Tropical Atlantic, Stations 346 to 349, surface.

4. *Castanidium murrayi*, n. sp. (Pl. 113, figs. 5, 5*a*).

Pores subregular, circular, without frames, three times as broad as the bars. Bristles three times as long as one pore. Radial main-spines cylindrical, stout, irregularly curved, longer than the shell-diameter, covered with longish hexagonal dimples, which are separated by a network of prominent crests (fig. 5*a*).

*Dimensions.*—Diameter of the shell 0·4 to 0·5, of the pores 0·02 to 0·025.

*Habitat.*—North Atlantic, Station 352 to 354, surface.

5. *Castanidium aldrichi*, n. sp.

Pores subregular, circular, without frames, of variable size, about as broad as the bars. Bristles four times as long as one pore. Radial main-spines conico-cylindrical, irregularly curved, straight, about as long as the radius. (The conical base of the spines is inflated and fenestrated, therefore the shell is nearly polyhedral.)

*Dimensions.*—Diameter of the shell 0·35 to 0·4, of the pores 0·012 to 0·015.

*Habitat.*—Central Pacific, Stations 270 to 274, surface.

6. *Castanidium bromleyi*, n. sp.

Pores irregular, roundish, two to four times as broad as the bars. Bristles half as long as the radius. Radial main-spines cylindrical, straight, slender, longer than the shell-diameter.

*Dimensions.*—Diameter of the shell 0·22 to 0·26, of the pores 0·006 to 0·02.

*Habitat.*—Indian Ocean and Southern Pacific, Stations 162 to 169, surface.

7. *Castanidium bethelli*, n. sp.

Pores irregular, roundish or polygonal, two to three times as broad as the bars. Bristles one-third as long as the radius. Radial main-spines conico-cylindrical, irregularly curved, with dimpled surface, somewhat longer than the radius.

*Dimensions.*—Diameter of the shell 0·5 to 0·6, of the pores 0·015 to 0·03.

*Habitat.*—North Pacific, Stations 235 to 245, surface.

8. *Castanidium moseleyi*, n. sp. (Pl. 113, fig. 2).

Pores irregular, roundish or polygonal, two to four times as broad as the bars. Bristles about as long as the diameter of one pore, or a little longer. Radial main-spines cylindrical, irregularly curved, somewhat longer than the diameter of the shell; their base is more or less inflated and fenestrated, therefore the shell is nearly polyhedral.

*Dimensions.*—Diameter of the shell 0·7 to 0·8, of the pores 0·01 to 0·04.

*Habitat.*—Tropical Atlantic, Stations 346 to 349, surface.

## Genus 708. *Castanissa*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Castanellida with simple radial main-spines and a dentate mouth.

The genus *Castanissa* agrees with the preceding *Castanidium* in the possession of large radial main-spines, scattered between the numerous bristles or by-spines of the surface; but it differs from it in the possession of teeth around the mouth, identical with those of *Castanella*; it may be derived therefore either from the latter by development of main-spines, or from the former by formation of teeth.

1. *Castanissa challengeri*, n. sp. (Pl. 113, fig. 1).

Pores regular, circular, three times as broad as the bars. Bristles one-fourth as long as the radius. Radial main-spines (about twelve) very stout, straight, cylindrical, at the distal end conical, pointed, with dimpled surface, about half as long as the radius. Mouth very large, circular, about one-third as broad as the shell, with a corona of twelve to sixteen very large, triangular, parallel teeth.

*Dimensions.*—Diameter of the shell 0·7 to 0·8, of the pores 0·03.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

2. *Castanissa pearceyi*, n. sp.

Pores regular, circular, twice as broad as the bars. Bristles half as long as the radius. Radial main-spines (about twenty) slender, cylindrical, smooth, irregularly curved, about as long as the radius. Mouth large, half as broad as the radius, with a corona of ten to twelve irregular, slender teeth.

*Dimensions.*—Diameter of the shell 0·5 to 0·6, of the pores 0·02.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

[1] *Castanissa* = Diminutive of *Castanea*.

3. *Castanissa richardsi*, n. sp.

Pores subregular, circular, about as broad as the bars. Bristles twice as long as one pore. Radial main-spines (about twenty) slender, cylindrical, irregularly curved, with dimpled surface (like those in Pl. **113**, fig. 5*a*). Mouth with a corona of six stout, parallel, triangular teeth.

*Dimensions.*—Diameter of the shell 0·3 to 0·35, of the pores 0·015.

*Habitat.*—North Atlantic, Station 354, surface.

4. *Castanissa crosbiei*, n. sp.

Pores irregular, roundish, two to three times as broad as the bars. Bristles one-third as long as the radius. Radial main-spines very numerous, straight, cylindrical, smooth, about as long as the diameter of the shell. Mouth with ten or twelve irregular, conical, parallel teeth.

*Dimensions.*—Diameter of the shell 0·28, of the pores 0·01 to 0·015.

*Habitat.*—North Pacific, Stations 231 to 235, surface.

5. *Castanissa macleani*, n. sp.

Pores irregular, roundish or polygonal, two to four times as broad as the bars. Bristles about one-fourth as long as the radius. Radial main-spines numerous, straight, conical, stout, with dimpled surface, shorter than the radius. Mouth with six to eight irregular conical teeth.

*Dimensions.*—Diameter of the shell 0·32, of the pores 0·012 to 0·024.

*Habitat.*—Tropical Pacific, Station 268, depth 2900 fathoms.

6. *Castanissa hoylei*, n. sp.

Pores irregular, polygonal, two to three times as broad as the bars. Bristles nearly half as long as the radius. Radial main-spines (about thirty) very long and thin, cylindrical, irregularly curved, at the conical base inflated and fenestrated; shell therefore slightly polyhedral. Mouth with five strong conical teeth.

*Dimensions.*—Diameter of the shell 0·35 to 0·4, of the pores 0·02 to 0·03.

*Habitat.*—North Pacific, Station 245 to 250, surface.

Genus 709. *Castanopsis*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Castanellida with branched radial main-spines and a simple smooth mouth.

The genus *Castanopsis* differs from its ancestral form *Castanidium* in the ramification of the radial main-spines; the branches are usually very irregular and often partly

[1] *Castanopsis* = Shell similar to a chestnut; κάστανον, ὄψις.

confluent. The shell is very similar to the Astrosphæride *Cladococcus* (compare above p. 223, Pl. 27), but differs from it in the possession of the shell-mouth, absent in all Sphæroidea.

1. *Castanopsis naresi*, n. sp. (Pl. 113, fig. 3).

Pores subregular, circular, about twice as broad as the bars. Bristles twice as long as one pore. Radial main-spines somewhat shorter than the diameter of the shell, straight, cylindrical, in the proximal half simple, in the distal half irregularly branched, each with ten to twelve partly confluent branches.

*Dimensions.*—Diameter of the shell 0·6 to 0·7, of the pores 0·02 to 0·03.

*Habitat.*—Tropical Atlantic, Station 347 to 349, surface.

2. *Castanopsis macleari*, n. sp.

Pores irregular, roundish, two to four times as broad as bars. Bristles half as long as the radius. Radial main-spines about as long as the radius, stout and straight, cylindrical, forked at the distal end, with two or three unequal fork-branches.

*Dimensions.*—Diameter of the shell 0·42, of the pores 0·015 to 0·03.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

3. *Castanopsis fergusoni*, n. sp.

Pores irregular, roundish or polygonal, about as broad as the bars. Bristles three times as long as one pore. Radial main-spines somewhat longer than the diameter of the shell, cylindrical, with irregular and partly confluent lateral branches (similar to Pl. 113, fig. 4*a*).

*Dimensions.*—Diameter of the shell 0·55, of the pores 0·012 to 0·016.

*Habitat.*—North Atlantic, Station 354, surface.

Genus 710. *Castanura*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Castanellida with branched radial main-spines and a dentate mouth.

The genus *Castanura* differs from the preceding *Castanopsis* in the possession of a corona of teeth surrounding the mouth, similar to that of *Castanissa*. It differs from the latter in the ramification of the radial main-spines, wherein it agrees with the former. *Castanura* may therefore be derived either from *Castanissa* by ramification of the main-spines, or from *Castanopsis* by development of teeth around the mouth.

[1] *Castanura* = Chestnut with tails ; κάστανον, οὐρά.

1. *Castanura tizardi*, n. sp. (Pl. 113, fig. 4, 4*a*).

Pores regular, circular, without hexagonal frames, twice as broad as the bars. Bristles twice as long as one pore. Radial main-spines somewhat longer than the radius, straight, very stout, with irregular lateral branches, which are partly confluent. Mouth with six strong conical teeth.

*Dimensions.*—Diameter of the shell 0·6, of the pores 0·03.

*Habitat.*—Tropical Atlantic, Station 346, surface.

2. *Castanura havergali*, n. sp.

Pores regular, circular, hexagonally framed, as broad as the bars. Bristles three times as long as one pore. Radial main-spines as long as the shell-diameter, in the basal half simple, in the distal half with irregular, not confluent, lateral branches. Mouth with ten to twelve irregular, parallel, conical teeth of different sizes.

*Dimensions.*—Diameter of the shell 0·5, of the pores 0·045.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

3. *Castanura swirei*, n. sp.

Pores regular, circular, hexagonally framed, as broad as the bars. Bristles half as long as the radius. Radial main-spines straight, longer than the shell-diameter; on the distal end with a few irregular, confluent, lateral branches. Mouth with six larger and six alternate smaller, parallel, conical teeth.

*Dimensions.*—Diameter of the shell 0·28, of the pores 0·015.

*Habitat.*—North Pacific, Station 253, surface.

4. *Castanura carpenteri*, n. sp.

Pores irregular, roundish, twice to four times as broad as the bars. Bristles about as long as the largest pores. Radial main-spines irregularly curved, longer than the shell-diameter, with inflated and fenestrated conical base; in the distal half irregularly branched, with simple, not confluent, lateral branches. Mouth with six to nine irregular, strong, conical teeth.

*Dimensions.*—Diameter of the shell 0·3, of the pores 0·012 to 0·025.

*Habitat.*—South Atlantic, Station 331, depth 1715 fathoms.

## Family LXXXI. CIRCOPORIDA, Haeckel, 1879 (Pls. 114–117).

*Circoporida*, Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—PHÆODARIA with a spherical or polyhedral shell, exhibiting a peculiar solid porcellanous structure, with a stellate circle of radial pores around the base of the hollow radial spines. Mouth usually with teeth. Surface of the shell

tabulate, panelled or dimpled. Central capsule excentric, placed in the aboral half of the shell-cavity.

The family Circoporida comprises those PHÆODARIA in which the simple, spherical, or polyhedral shell exhibits a peculiar porcellanous structure, possesses a simple mouth, and is particularly distinguished by the constant character denoted by their name, viz., by circles of pores surrounding the base of the radial spines. It agrees in these striking peculiarities with the following family, the Tuscarorida, but differs from them essentially by the spherical or polyhedral form of the shell, which is never ovate, with the main axis prolonged. The radial spines, variable in number, are regularly or symmetrically disposed in all Circoporida, whilst they are arranged around the poles of the main axis in all Tuscarorida. Whilst the latter are always extremely large, more than a millimeter in size, the former are much smaller and never reach the diameter of a millimeter. The number of genera and species in this family is not large, and the majority are very rare, but they belong to the most remarkable Radiolaria by the peculiar structure, as well as by the geometrical regularity of the polyhedral shell.

The Circoporida may be divided into two different subfamilies, the Circogonida and the Haeckelinida. The latter are represented by the single genus *Haeckeliana* (Pl. 114), and possess a spherical shell with numerous small dimples between the circles of pores, and numerous simple radial spines which do not exhibit a regular arrangement. The Circogonida, on the other hand, comprise all other genera (Pls. 115–117), and possess a panelled shell with polygonal plates, and a certain number of radial spines, which are regularly disposed on the corners of the polyhedral shell, and usually armed with verticillate bristles and terminal forks or spathillæ. Perhaps the Circogonida and Haeckelinida may better be considered as two separate families.

The geometrical fundamental form of the shell is in the Circoporida of the highest interest, since it exhibits regular proportions, which are very rare in other organic forms, generally some rare forms of regular polyhedrons. The shell in all members of this family belongs to that group of geometrical forms which I have called in my General Morphology "*Polyaxonia*" (vol. i., 1866, pp. 406–416). The shell therefore is constantly an "endospherical polyhedron," *i.e.*, a polyhedron, all the corners of which lie in a spherical surface. The corners are always indicated by the bases of the radial spines arising from the surface of the shell and marking its axes, and it is immaterial whether the shell itself is a true polyhedron or a sphere; for in the latter case also the radial spines mark the axes of the polyhedron.

The six genera, which we here distinguish among the Circoporida, represent six different fundamental forms. *Circoporus* (Pl. 115, figs. 1–3; Pl. 117, figs. 5, 6) possesses six radial spines, opposite in pairs in three diameters, perpendicular one to another; it agrees therefore with the Cubosphærida (p. 169, Pls. 21–25) and repre-

sents the regular octahedron, with eight congruent triangular faces and six corners. It has the same form as the well-known antheridia of Chara (Gener. Morphol., vol. i. p. 412). *Circogonia* (Pl. 115, figs. 8–10; Pl. 117, fig. 1) exhibits twelve radial spines, opposite in pairs in six equidistant diameters. The surface of the shell is divided into twenty equal and equilateral triangles, and agrees therefore with the regular icosahedron. The same form appears also in some forms of *Aulosphæra*, and in several Astrosphærida (Gener. Morphol., vol. i. p. 411). *Circorrhegma* (Pl. 117, fig. 2) possesses a regular shell with twelve equal pentagonal faces and twenty equidistant corners, from which arise twenty regularly disposed radial spines. It represents therefore the regular "pentagonal dodecahedron," the same remarkable form which is found in some Astrosphærida, and in the pollen-grains of some plants, *e.g.*, *Bucholzia maritima*, *Fumaria spicata*, *Polygonum amphibium*, &c. (Gener. Morphol., vol. i. p. 412, Taf. ii. fig. 18 .

The three genera of Circoporida mentioned therefore represent three different forms of regular polyhedrons, in the exact mathematical sense, viz., *Circoporus*, the regular octahedron, *Circogonia*, the regular icosahedron, and *Circorrhegma*, the regular dodecahedron. In each of these three regular forms all the faces, edges, and corners are equal. The remaining three genera of Circoporida represent, however, three forms of subregular or irregular endospherical polyhedra, which are not perfectly regular. *Circospathis* (Pl. 115, figs. 4–7; Pl. 117, fig. 3) is a rather common form, and constantly possesses nine symmetrically disposed radial spines; the shell is either spherical or polyhedral, with fourteen triangular faces and thirty edges; the nine spines lie in three meridional planes, which are crossed at equal angles (three equidistant spines in each plane). We call this remarkable form the tetradecahedron; it appears also in some Astrosphærida (*e.g.*, in *Haliomma echinaster*, figured in my Monograph, Taf. xxiv. fig. 1). *Circostephanus* (Pl. 116, fig. 3) exhibits a subregular polyhedral shell with a variable number of triangular faces and of radial spines (twenty-four to forty or more). *Circostephanus sexagenarius* possesses sixty triangular equilateral faces, which are disposed in twelve pentagonal groups (each with five faces), so that the shell seems to be derived from a regular pentagonal dodecahedron, the twelve regular faces of which are divided each into five congruent triangles. From its corners arise thirty-two radial spines (twelve from the central points of the pentagons, twenty from the meeting corners of every three pentagons). In other cases the number of faces and radial spines seems to be larger and their arrangement more irregular. The same may be said of *Haeckeliana*, in which the dimpled shell is constantly spherical, and possesses a variable number of radial spines, from sixteen to fifty-five (usually between thirty and forty).

The structure of the shell in the Circoporida is the same as in the Tuscarorida, of a peculiar porcellanous nature. The shell-wall is very thick, more or less opaque, and in direct light whitish or yellowish. Its surface is dimpled, with numerous small, circular,

roundish or polygonal dimples in *Haeckeliana* (Pl. 114, figs. 1–6). In the Circogonida, however, the surface is panelled, with regular or irregular polygonal plates, often separated by high prominent crests (Pl. 115, figs. 4–9, &c.). Numerous simple thin needles of silica lie tangentially disposed and irregularly scattered in the porcellanous or cement-like substance of the thick shell-wall. Under a strong lens this substance appears finely punctate, being probably pierced by numerous very fine pores. The surface of the shell is therefore minutely roughened, and often appears quite black under the microscope, by the adhesion of innumerable fine air-bubbles. In all Circoporida, as well as in the Tuscarorida, the porcellanous shell has not the perfect transparency of the purely siliceous shells of other Radiolaria; its refractive power is somewhat different from the latter; it becomes deeply stained by carmine and browned by fire, and seems therefore to consist of a peculiar carbonic silicate.

The shell in all Circoporida exhibits a simple, excentric mouth, which corresponds to the main osculum of the central capsule. The excentric position of this shell-mouth has no influence on the regular form of the shell. The mouth is either circular or polygonal, usually about as large as a basal circle of pores. It is always armed with prominent conical or pyramidal teeth, the number of which is variable and seems to depend partly upon the number of the shell-faces or the radial spines. *Circoporus* has usually four cruciate teeth (Pl. 115, fig. 1; Pl. 117, figs. 4, 5). *Circorrhegma* exhibits a pentagonal mouth with five teeth (Pl. 117, fig. 2). *Circogonia* possesses a hexagonal mouth with six teeth (Pl. 115, fig. 8; Pl. 117, fig. 1). *Circospathis* has no constant number; some species have five teeth (Pl. 115, fig. 4), others four (Pl. 115, fig. 10), others nine (Pl. 117, fig. 3*a*). *Circostephanus* is also variable; one species exhibits eight teeth (Pl. 116, fig. 3*a*), another ten, another twelve. In *Haeckeliana* (Pl. 114, fig. 3) the teeth are smaller and more numerous. Usually the teeth arise vertically from the surface of the shell and are spinulate; more rarely their points are directed towards the centre of the mouth. Sometimes numerous thin needles arise between the teeth (Pl. 115, fig. 10).

The radial spines of the Circoporida are tubular, usually cylindrical and conical at the thickened base, more rarely prismatic or slenderly pyramidal, with three or more edges; sometimes the edges are spirally wound around the axis (Pl. 115, fig. 6). In the majority of species their length is about equal to the diameter of the shell; often they are somewhat shorter, more rarely longer. Their tubular structure is always the same as in the Tuscarorida; the wall of the tube is thick, and in the axis of its cavity lies an axial cord or funicle, which is connected with the wall by numerous horizontal, simple, or branched threads (Pl. 115, figs. 6, 7). The axial funicle itself is either a simple thread of silica, or a strand, composed of three to fifteen or more filaments, which are closely twisted like a rope around the axis of the spine, and arise separately from the bridges between the pores of the basal circle (Pl. 115, figs. 7, 9). The number of

pores in these circles is very variable, commonly from three to nine, sometimes twelve to fifteen or more; their form is usually irregularly ovate (Pl. 115, figs. 7, 9). The bridges between the pores usually bear numerous siliceous threads or bristles, which are curved downwards or upwards (Pl. 115, figs. 4–6). Sometimes the spines are entirely covered with similar bristles or cilia (Pl. 117, figs. 2–5), more rarely with regular verticils of lateral branches (Pl. 117, fig. 6).

The distal ends of the radial spines are simple in *Haeckeliana* (Pl. 114), whilst in the other Circoporida they are usually (or perhaps constantly) either forked or armed with a verticil of terminal branches. When the spines are simply forked, their two terminal branches lie in certain meridional planes (Pl. 117, fig. 5). The same is probably the case when they bear three divergent branches (Pl. 115, figs. 1, 2), or four crossed branches (Pl. 117, figs. 4, 6). The larger species usually bear a corona of five curved branches disposed around the distal apex of each spine (Pl. 116, fig. 3; Pl. 117, figs. 1, 2). Sometimes the formation of these coronas is twice or more often repeated, so that the spines appear verticillate.

The *central capsule* of the Circoporida (Pl. 115, fig. 8; Pl. 117, fig. 6) is usually about half as large as the enclosing shell, and lies excentrically in that half of its cavity which is remote from the shell-mouth (Pl. 115, fig. 8). The other half (near the mouth) is filled up by the cap-shaped, dark phæodium. The proboscis, or the central tubule of the astropyle, is hidden in the axis of the blackish phæodium, and is directed towards the mouth of the shell; it is often S-shaped, more or less curved. The circular radiate operculum of the astropyle, placed on the base of the proboscis, exhibits numerous branched radial ribs, and closes the main-opening like the lid of a tea-kettle (Pl. 115, fig. 3). The number of the parapylæ, or the accessory openings of the capsule, which in the majority of PHÆODARIA is two, seems to be usually increased in the Circoporida. In *Circoporus* the capsule seems to possess six and in *Circospathis* nine secondary openings, and therefore there is some probability that each circle of pores on the base of a radial spine corresponds to a secondary opening of the capsule. In *Haeckeliana*, however (Pl. 114), I could observe no parapylæ at all. These accessory openings are always very small in the Circoporida, and may be easily overlooked. Futhermore, the number of observations respecting this difficult point is too small, and their certainty not satisfactory; it requires therefore further accurate examination, as also does the whole central capsule of the Circoporida.

The numerous and remarkable characters of shape and structure, which we have described above as occurring in the Circoporida, are also found in the following closely allied family, the Tuscarorida; all the species are inhabitants of great depths. Perhaps it may therefore be more convenient to separate these two families from the other PHÆOGROMIA as a peculiar order, under the name PHÆOCALPIA.

*Synopsis of the Genera of Circoporida.*

| | | | |
|---|---|---|---|
| I. Subfamily Circogonida. Shell spherical or polyhedral with panelled structure and polygonal plates. A certain number of radial spines are geometrically disposed. | Shell octahedral (or spherical), | Six radial spines, | 711. *Circoporus.* |
| | Shell tetradecahedral, | Nine radial spines, | 712. *Circospathis.* |
| | Shell icosahedral, | Twelve radial spines, | 713. *Circogonia.* |
| | Shell dodecahedral, | Twenty radial spines, | 714. *Circorrhegma.* |
| | Shell polyhedral, | Twenty-four to forty or more radial spines, | 715. *Circostephanus.* |
| II. Subfamily Haeckelinida. | Shell spherical, with dimpled structure, and a variable number of radial spines (without polygonal plates), | | 716. *Haeckeliana.* |

## Subfamily 1. Circogonida, Haeckel.

*Definition.*—Circoporida with panelled shell, composed of polygonal plates. The shell is usually polyhedral, more rarely spherical, and the radial spines are usually (or perhaps constantly) branched and regularly arranged.

### Genus 711. *Circoporus*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Circoporida with a spherical or regularly octahedral shell, composed of eight congruent, triangular plates, with six corners from which arise six radial spines, opposite in pairs in three diameters, perpendicular one to another.

The genus *Circoporus*, the simplest among the Circoporida, is distinguished by the regular octahedral form of the shell, with the three equal axes of the regular crystalline system perpendicular one to another. Six equal radial spines, arising from the six corners, lie opposite in pairs in those three dimensive axes. The eight equal triangular faces of the octahedron are sometimes plane, sometimes concave or convex, and sometimes the shell becomes spherical. In this case it becomes very similar to the Hexastylida among the Sphæroidea.

#### 1. *Circoporus sexfurcus*, Haeckel (Pl. 117, fig. 5).

*Challengeria* sp., John Murray, 1876, Proc. Roy. Soc. Lond., vol. xxiv. pl. xxiv. fig. 5.

Shell spherical, covered with irregular, polygonal plates. Six radial spines shorter than the diameter of the shell, covered with thin curved bristles, in the proximal half cylindrical, in the distal half forked, each with two equal curved fork-branches. Around the ciliated base of each spine a

[1] *Circoporus* = Shell with circles of pores; κίρκος, πόρος.

corona of twelve to sixteen pores surrounded by a circle of numerous, curved, longer bristles. Mouth cruciform, with four triangular, convergent teeth.

*Dimensions.*—Diameter of the shell 0·55, length of the spines 0·4.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

2. *Circoporus hexastylus*, n. sp. (Pl. **117**, fig. 4).

Shell regularly octahedral, with eight plane, congruent, triangular faces, which are covered with a very delicate network of small, regular, hexagonal plates. Six radial spines as long as the radius of the shell, four-sided pyramidal, simple, in the basal half covered with numerous curved bristles. Around the base of each spine a corona of four equal pores, surrounded by a circle of twelve short teeth. Apex with four crossed, curved branches (like those of *Circospathis tetrodon*). Mouth cruciform, with four smooth teeth.

*Dimensions.*—Diameter of the shell 0·24, length of the spines 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

3. *Circoporus characeus*, n. sp.

Shell spherical, covered with a delicate network of irregular polygonal plates. Six radial spines longer than the diameter of the shell, cylindrical, covered with numerous curved bristles, each with eight pores at the base surrounded by a circle of long bristles. Apex of each spine with a trident or fuscina, similar to that of the following species. Similar to an antheridium of Chara.

*Dimensions.*—Diameter of the shell 0·32, length of the spines 0·4.

*Habitat.*—South Pacific, Station 285, depth 2375 fathoms.

4. *Circoporus sexfuscinus*, n. sp. (Pl. **115**, figs. 1–3).

Shell subregular, octahedral, with eight triangular, concave, somewhat unequal faces, which are covered with an extremely delicate network of small square dimples, and furrowed by radial crests arising from the bases of the spines (fig. 2). Six radial spines about as long as the diameter of the shell, four-sided, prismatic, with rounded edges; each in the basal half with a verticil of four crossed, curved bristles (fig. 1), sometimes with two verticils (fig. 2); on the distal apex inflated, armed with a trident or fuscina. Around the base of each spine four crossed elliptical pores. Mouth cruciform, with four small teeth (fig. 1).

*Dimensions.*—Diameter of the shell 0·2 to 0·25, length of the spines 0·2 to 0·25.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

5. *Circoporus octahedrus*, n. sp. (Pl. **117**, fig. 6).

Shell regularlyoctahedral, with eight plane, or slightly convex, congruent, triangular faces, which are covered with very small, regular, triangular plates (like those of *Polypetta tabulata*, Pl. **116**, fig. 2). Six stout radial spines, about as long as the diameter of the shell, four-sided prismatic,

covered with three or four verticils of four long curved bristles; at the distal apex inflated, with four crossed, divergent, stout, curved horns. Around the pyramidal base of each spine a corona of eight pores (two on each of the four faces). Mouth cruciform, with four triangular, convergent teeth.

*Dimensions.*—Diameter of the shell 0·16, length of the spines 0·18.

*Habitat.*—South Pacific, Station 298, depth 2225 fathoms.

## Genus 712. *Circospathis*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Circoporida with a subregular, spherical, or polyhedral shell, composed of fourteen triangular, nearly equal plates, with nine corners, from which arise nine radial spines, symmetrically disposed.

The genus *Circospathis* exhibits the remarkable and peculiar form of a "Tetradecahedron," or a subregular polyhedron with fourteen triangular faces, thirty edges, and nine corners, from which arise nine radial spines. These lie in three meridional planes, which are crossed at equal angles (three equidistant spines in each plane). The same interesting form occurs also in some Astrosphærida, which bear nine regularly disposed radial spines, as *Haliomma echinaster*. All four observed species of *Circospathis* are South Atlantic.

### 1. *Circospathis furcata*, n. sp. (Pl. 115, figs. 4–6).

Shell polyhedral or nearly spherical, with nine prominent corners, from which arise nine radial spines, about as long as the diameter of the shell. The polygonal plates of the shell are separated by high crests, usually hexagonal or pentagonal, irregular, about twelve to fifteen on the half meridian. Radial spines cylindrical, straight, about as long as the diameter of the shell, with spirally turned edges, covered with numerous curved bristles, at the distal end forked; the two fork branches curved, one-third as long as the simple basal part. The inflated base of each spine is surrounded by a corona of nine to twelve ovate basal pores. Mouth pentagonal, with five thick, mammillate and spinulate, somewhat convergent teeth (fig. 5).

*Dimensions.*—Diameter of the shell 0·6, length of the spines 0·5.

*Habitat.*—South Atlantic (east of Buenos Ayres), Station 325, depth 2650 fathoms.

### 2. *Circospathis novena*, n. sp. (Pl. 117, figs. 3, 3*a*).

Shell polyhedral (tetradecahedral), with fourteen triangular, plane, or slightly convex faces, covered with small, irregular, polygonal (usually hexagonal) plates, and nine prominent corners, from which arise nine radial spines, shorter than the diameter of the shell. Each spine is surrounded at the broader base by a circle of twelve to sixteen pores and a corona of bristles, and bears at the

[1] *Circospathis* = Shell with verticils around the spines; κίρκος, σπαθίς.

inflated distal apex a trident or fuscina, similar to that of *Circoporus sexfuscinus* (Pl. 115, fig. 2). Mouth with nine convergent, conical, denticulate teeth (fig. 3*a*).

*Dimensions.*—Diameter of the shell 0·6, length of the spines 0·4.

*Habitat.*—South Atlantic, Station 318 (east of Patagonia), depth 2040 fathoms.

3. *Circospathis tetradeca*, n. sp.

Shell spherical, covered with irregular, polygonal plates. Nine radial spines, cylindrical, as long as the radius of the shell, bristly, armed at the distal apex with a trident. (In one specimen six spines possessed three terminal branches, two spines two branches, and one spine four branches.) The broader base of each spine is surrounded by a corona of nine pores and a circle of curved bristles. Mouth with nine smooth conical teeth.

*Dimensions.*—Diameter of the shell 0·55, length of the spines 0·3.

*Habitat.*—South Atlantic, Station 332 (west of Tristan da Cunhá), depth 2200 fathoms.

4. *Circospathis tetrodonta*, n. sp. (Pl. 115, fig. 10).

Shell subspherical or polyhedral, with fourteen triangular, convex faces, covered with irregular polygonal plates. Nine radial spines cylindrical, nearly smooth, about as long as the diameter of the shell; at the distal apex with four strong curved horns, like those of *Circoporus hexastylus*, Pl. 117, fig. 4. Each spine is surrounded at the base by a corona of nine irregular pores. Mouth with four large, prominent, conical teeth, which are spinulate, with vertical inner edge (fig. 10).

*Dimensions.*—Diameter of the shell 0·5, length of the spines 0·45.

*Habitat.*—South Atlantic, Station 323 (east of Buenos Ayres), depth 1900 fathoms.

## Genus 713. *Circogonia*,[1] n. gen.

*Definition.*—Circoporida with a regular icosahedral shell, composed of twenty congruent, triangular plates, with twelve corners, from which arise twelve radial spines.

The genus *Circogonia* is remarkable for the regular icosahedral form of its shell, a geometrical fundamental form, which occurs very rarely in organised bodies (as in *Aulacantha icosahedra*, and in some Astrosphærida with twelve regularly disposed radial spines). The shell is composed of twenty triangular, equilateral and congruent plates, which are sometimes separated by prominent crests; their surface is panelled by smaller hexagonal or polygonal secondary plates. The thirty edges between the plates are sometimes thickened. From the twelve corners of the regular icosahedron (where every five triangular plates meet), twelve equal radial spines arise, each of which is surrounded at the base by a corona of nine to sixteen pores. Two species only of *Circogonia* have been observed; the one has smooth spines, forked at the distal end,

[1] *Circogonia* = Polyhedron with circles of pores; κίρκος, γωνία.

the other bears numerous curved bristles around each spine, and at the distal end a verticil of five curved branches. The mouth of the shell (placed in the centre of one of the triangular plates) is in both species armed with six teeth. Both species are found in the Tropical Atlantic.

1. *Circogonia icosahedra*, n. sp. (Pl. **117**, figs. 1, 1*a*).

Shell regularly icosahedral, with twenty equal, triangular, nearly plane faces, which are separated by thirty prominent, crest-like edges, and covered by a delicate network of small, subregular, hexagonal plates. Twelve radial spines nearly conical, one and a half times as long as the radius of the shell, with five prominent edges. The campanulate base of each spine is covered with numerous long, curved bristles, surrounded by a circle of twelve to sixteen ovate, irregular pores, and separated from the slender distal part by a constriction. The distal apex of the spine is surrounded by a verticil of five conical, curved branches (corresponding to the five edges of the spines, and to the five faces, which meet in the corners where the spine arises). Mouth hexagonal, with six conical, spinulate teeth, convergent towards its centre (fig. 1*a*).

*Dimensions.*—Diameter of the shell 0·75, length of the spines 0·5.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

2. *Circogonia dodecacantha*, n. sp. (Pl. **115**, figs. 8, 9).

Shell subregularly icosahedral, with twenty equal, triangular, slightly convex faces, which are not separated by prominent crests, but covered with a network of irregular polygonal plates. Twelve radial spines, cylindrical, smooth, about as long as the diameter of the shell, forked at the distal end, with two divergent, slightly curved branches (similar to *Circospathis furcata*, Pl. **115**, figs. 4–6). The conical base of each spine is surrounded by a circle of nine to twelve irregular, ovate pores (fig. 9). Mouth circular, with a corona of six conical, smooth teeth which arise perpendicularly from the shell (in the upper part of fig. 8, at left).

*Dimensions.*—Diameter of the shell 0·6, length of the spines 0·7.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

## Genus 714. *Circorrhegma*,[1] n. gen.

*Definition.*—Circoporida with a regular dodecahedral shell, composed of twelve congruent, pentagonal plates, with twenty corners, from which arise twenty radial spines.

The genus *Circorrhegma* is remarkable for the geometrical regularity of its shell, which represents a pentagonal dodecahedron. The shell is therefore composed of twelve equal and regular pentagonal plates, and these are separated in the only known

[1] *Circorrhegma* = Shell with circles of fissures ; κίρκος, ῥῆγμα.

species by thirty prominent crest-like edges. From the corners of the dodecahedron, at which every three pentagons meet, arise twenty radial spines, opposite in pairs in ten equidistant axes.

1. *Circorrhegma dodecahedra*, n. sp. (Pl. 117, figs. 2, 2*a*).

Shell dodecahedral, with twelve equal and regular, plane, pentagonal plates, which are separated by thirty prominent crests, and bear a network of numerous polygonal (usually also pentagonal), smaller plates. Twenty radial spines about as long as the radius of the shell, three-sided prismatic, covered with numerous bristles; each surrounded at the thickened base by a circle of twelve to sixteen pores, and at the distal apex by a corona of five curved, terminal branches. Mouth pentagonal, with five conical, subvertical, spinulate teeth (fig. 2*a*).

*Dimensions.*—Diameter of the shell 0·8, length of the spines 0·5.

*Habitat.*—Indian Ocean, Madagascar (Rabbe).

Genus 715. *Circostephanus*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 5.

*Definition.*—Circoporida with a subregular, polyhedral or nearly spherical shell, composed of thirty to sixty or more triangular plates, with twenty-four to thirty-two or more corners, from which arise radial spines, symmetrically disposed.

The genus *Circostephanus* comprises those Circoporida in which the porcellanous shell is an endospherical polyhedron, with numerous (thirty to sixty or more) triangular faces, and has a variable number of radial spines (twenty-four to forty or more), arising from its corners. The number of faces and corners seems to be variable in this genus, but may perhaps be typical in some species. *Circostephanus sexagenarius* has the typical form of a "Sexagenal-Polyhedron," with sixty equal triangular faces and thirty-two corners, and may be derived from the "Pentagonal-Dodecahedron" (*Circorrhegma*) by dividing its twelve pentagonal faces each into five congruent triangles.

1. *Circostephanus coronarius*, n. sp. (Pl. 116, figs. 3, 3*a*, 3*b*).

Shell polyhedral, with thirty-two to forty triangular, concave faces of nearly equal size, which are separated by high prominent crests. From the elevated corners of the polyhedron arise twenty-four to thirty radial spines, which are three-sided prismatic or nearly cylindrical, about as long as the radius of the shell, and covered with long curved bristles. The distal end of each spine is surrounded by a verticil of five stout, curved branches, its pyramidal base by a corona of five (or

[1] *Circostephanus*=Shell with circular coronets; κίρκος, στέφανος.

sometimes six) ovate, basal pores (fig. 3*b*). Mouth armed with a corona of eight short, conical, vertical, spinulate teeth (fig. 3*a*).

*Dimensions.*—Diameter of the shell 0·4 to 0·5, length of the spines 0·2 to 0·25.

*Habitat.*—South-Eastern Pacific (off Valparaiso), Station 298, depth 2225 fathoms.

2. *Circostephanus sexagenarius*, n. sp.

Shell polyhedral, with sixty triangular, equilateral, congruent faces, which are nearly plane, and separated by high prominent crests. They are disposed in twelve pentagonal groups, each with five faces, so that they appear as if derived from a regular pentagonal dodecahedron, the twelve regular faces of which are each divided into five congruent triangles, meeting in its centre. From the elevated corners of the polyhedron arise thirty-two radial spines (twelve in the central points of the pentagons, twenty in the meeting corners of every three pentagons). The radial spines are nearly as long as the diameter of the shell, cylindrical, spinulate, and surrounded at the distal end by a verticil of five stout, curved branches, and at the pyramidal base by a corona of twelve to sixteen basal pores. Mouth armed with a corona of twelve conical, vertical, spinulate teeth.

*Dimensions.*—Diameter of the shell 0·75, length of the spines 0·6.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

3. *Circostephanus polygonarius*, n. sp.

Shell polyhedral, with sixty to eighty subregular, triangular, concave faces, which are separated by prominent crests. From the elevated corners of the polyhedron arise thirty to forty radial spines, which are longer than the diameter of the shell, densely covered with curved bristles and three-sided prismatic, with three spirally convoluted edges. Their distal end is surrounded by a verticil of eight or nine curved branches, and their pyramidal base by a corona of eight or nine basal pores. Mouth armed with a corona of ten conical, vertical, spinulate teeth.

*Dimensions.*—Diameter of the shell 0·8, length of the spines 0·9.

*Habitat.*—South Pacific, Station 288, depth 2600 fathoms.

## Subfamily 2. HAECKELINIDA.

*Definition.*—Circoporida with dimpled spherical shell, not composed of polygonal plates. The shell is covered with small roundish dimples, never polyhedral, and the radial spines are simple, not branched, and usually not regularly arranged.

### Genus 716. *Haeckeliana*, John Murray, 1879, *in schedulis*, Chall. Coll.

*Definition.*—Circoporida with spherical shell of a peculiar dimpled, porcellanous structure, and with a variable number of simple radial main-spines which are usually not regularly arranged.

The genus *Haeckeliana* comprises the spherical Circoporida, with dimpled, porcellanous shell, which are widely distributed, but rather rare, in depths between 2000 and 3000 fathoms. All the known species (six in number) are very closely related, and though the extreme forms appear very different in size and structure, they are so connected by a continuous series of intermediate forms, that they may be regarded as varieties of a single species, first observed by Dr. John Murray, and called by him *Haeckeliana porcellana*. The number of radial spines may be from sixteen to fifty-five, and is usually between thirty and forty. Each is surrounded by a basal coronet of aspinal pores, usually five, more rarely four or six; the number, however, is not constant in any one species. Each coronet is armed with an outer ring of by-spines. The surface of the shell between the coronets is dimpled. The mouth (Pl. 114, fig. 3) is about as large as a corona, and also armed with a ring of by-spines. The structure of the thick porcellanous shell and the radial spines is different from the other Circoporida.

1. *Haeckeliana porcellana*, John Murray (Pl. 114, fig. 6).

*Haeckeliana porcellana*, John Murray, 1879, *in schedulis*, Chall. Coll.

Shell with forty to forty-five coronets, the majority of which have five pores (more rarely four or six). Coronets broader than their intervals, and twice as broad as the length of the by-spines. Dimples subcircular, of the same breadth as the pores. Main-spines about as long as the radius.

*Dimensions.*—Diameter of the shell 0·37 to 0·42, of the coronets 0·06 to 0·07.

*Habitat.*—South Pacific, Stations 289 to 293, depth 2025 to 2550 fathoms.

2. *Haeckeliana maxima*, n. sp. (Pl. 114, fig. 5).

Shell with fifty to fifty-five coronets, the majority of which have six pores (more rarely five or seven). Coronets broader than their intervals, and eight to ten times as broad as the length of the by-spines. Dimples irregularly polygonal, of about the same breadth as the pores. Radial main-spines about as long as the diameter of the shell.

*Dimensions.*—Diameter of the shell 0·5 to 0·52, of the coronets 0·08 to 0·09.

*Habitat.*—Equatorial Atlantic, Station 347. depth 2250 fathoms.

3. *Haeckeliana lamarckiana*, n. sp. (Pl. 114, fig. 4).

Shell with thirty-five to forty coronets, the majority of which have five pores (more rarely six or four). Coronets broader than their intervals; each funnel-shaped pore on the inside with a circle of small conical thorns. By-spines rudimentary or wanting. Dimples irregularly polygonal, half as broad as the pores. Radial main-spines shorter than the radius.

*Dimensions.*—Diameter of the shell 0·38 to 0·45, of the coronets 0·06 to 0·07.

*Habitat.*—South Atlantic, Stations 318 to 333, depth 2000 to 2900 fathoms.

4. *Haeckeliana murrayana*, Haeckel.

*Challengeria* sp., John Murray, 1876, Proc. Roy. Soc., vol. xxiv. pl. xxiv. fig. 6.

Shell with twenty to twenty-five coronets, the majority of which have five pores (more rarely four or six). Coronets of about the same breadth as their intervals, and twice as broad as the by-spines. Dimples subcircular, of about the same breadth as the pores. Radial main-spines about as long as the radius.

*Dimensions.*—Diameter of the shell 0·35 to 0·4, of the coronets 0·06 to 0·07.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

5. *Haeckeliana goetheana*, n. sp. (Pl. 114, fig. 3).

Shell with sixteen to twenty coronets, the majority of which have four pores (more rarely five and very rarely six). Coronets smaller than their intervals. By-spines very short or rudimentary. Dimples subcircular, half as broad as the pores. Radial main-spines shorter than the radius.

*Dimensions.*—Diameter of the shell 0·25 to 0·3, of the coronets 0·04 to 0·05.

*Habitat.*—North Pacific (south of Japan), Station 231, depth 2250 fathoms.

6. *Haeckeliana darwiniana*, n. sp. (Pl. 114, figs. 1, 2).

Shell with twenty-six to thirty-two coronets, the majority of which have five pores (rarely four or six). Coronets smaller than their intervals and than the length of the by-spines. Dimples subcircular, half as broad as the pores. Radial main-spines longer than the radius.

*Dimensions.*—Diameter of the shell 0·30 to 0·42, of the coronets 0·07 to 0·08.

*Habitat.*—North Pacific (east of Japan), Stations 241 to 245, depth 2300 to 2900 fathoms.

## Family LXXXII. TUSCARORIDA, n. fam. (Pl. 100).

*Definition.*—PHÆODARIA with an ovate, spindle-shaped, or nearly spherical shell exhibiting a peculiar solid porcellanous structure; with a few radial pores around the base of the hollow tubules, which are symmetrically arranged around the main axis and the mouth. Surface of the shell smooth or spiny, not tabulate nor panelled. Central capsule excentric, placed in the aboral half of the shell-cavity.

The Tuscarorida, and the preceding closely allied family, the Circoporida, represent together a peculiar small group, which differs from the other PHÆODARIA in the singular porcellanous structure of the shell-wall, and may be called Phæocalpia; their hollow radial spines are distinguished by peculiar basal pores, forming a circle around their base. The shell of the Tuscarorida is monaxonian, ovate, spindle-shaped

or nearly spherical, whilst in the Circoporida it is polyaxonian, spherical or polyhedral; the hollow radial spines are arranged in the former around the main axis, in the latter around the common central point. All Phæocalpia (the Tuscarorida as well as the Circoporida) are inhabitants of great depths, usually between 2000 and 3000 fathoms.

Though the number of Tuscarorida at present known is small (only three genera, with ten species), they represent a very distinct and remarkable family of PHÆODARIA, as well by their considerable size, as by the peculiar arrangement of the radial spines and the structure of the shell-wall, which in some species is more solid and thicker than in any other Radiolaria. The diameter of the shell is always more than 1 mm., usually between 1 and 2, and sometimes more than 3 mm.

The dry shell of the Tuscarorida is not hyaline and transparent as is usual in the other Radiolaria, but perfectly opaque, milk-white or yellowish-white. This opacity is caused by innumerable very fine pores, which everywhere pierce the thick, apparently solid, fundamental substance of the shell-wall. Besides those very small pores, it is also pierced by a certain number of larger pores, which are scattered at wide distances (Narr. Chall. Exp., vol. i. pl. A, fig. 15*b*). These larger pores or pore-channels have a diameter of about 0·01 mm., and pierce the shell-wall either in a perpendicular or in an oblique direction. Very numerous straight, simple, and thin needles, usually 0·1 to 0·2 mm. in length, similar to the thin tangential needles of the Aulacanthida, are everywhere scattered tangentially in the cement-like fundamental substance, which seems to be a peculiar carbonic silicate; their axis is parallel to the shell-surface.

The general form of the shell is somewhat different in the three genera of Tuscarorida; ovate or spherical in *Tuscarora* and *Tuscarusa*, which bear no caudal axial spine (Pl. 100, figs. 1–7), or sometimes three-sided pyramidal (fig. 4); it is spindle-shaped in *Tuscaridium*, which bears on the aboral pore an axial caudal spine (Pl. 100, fig. 8). In every case the main axis of the shell, determining its monaxonian fundamental form, is indicated by the mouth, which is placed in the oral pole of the main axis and prolonged into a short tube or proboscis.

The hollow apophyses, arising from the shell of the Tuscarorida, are always cylindrical, long and thin tubules, the narrow cavity of which communicates directly with the large shell-cavity. In the axis of the tubules lies a thin axial chord or funicle, composed of a few (usually three or four) siliceous threads which arise from bridges between the basal pores of the apophyses, and are twisted together like the strands of a rope. The axial funicle is connected with the thin wall of the tubular apophyses by innumerable very thin radial beams, perpendicular to the axis (Pl. 100, fig. 3*a*, 5*b*). The surface of the apophyses is almost constantly covered with numerous small bristles or spines, which are usually curved and directed towards their distal ends.

*Tuscarora* (Pl. 100, figs. 1–6) exhibits two different groups of apophyses, which may be distinguished according to their different position and direction as "circoral"

teeth" and "aboral feet"; the teeth immediately surround the opening of the mouth, whilst the feet are remote from it and usually placed in the aboral half of the body, more rarely in the equator or in the oral half. The general form and structure are the same in both groups of apophyses, but their position and direction is different; the circoral teeth are directed forwards, often parallel (at the base at least), while the aboral feet are either divergent and directed backwards, or they diverge forwards in the basal part, then form a large arch, and finally curve backwards.

The number of the aboral feet, and their position relative to the circoral teeth, are different but probably constant in each single species, and serve, in the first place, for the distinction of genera and species. *Tuscarora* (in restricted sense) (Pl. 100, figs. 1–6), has constantly three feet (comparable to the three cortinar feet of the tripodal NASSELLARIA); *Tuscarusa* (Pl. 100, fig. 7) has four feet, opposite in pairs and forming a regular cross; *Tuscaridium*, finally (Pl. 100, fig. 8), has only one foot, which is situated in the main axis, on its aboral pole, and may therefore be called a caudal spine.

The number of the circoral teeth varies from two to four, and is usually three. Originally these three teeth alternate regularly with the three aboral feet, so that the latter may be regarded as perradial, the former as interradial (Pl. 100, figs. 1–4). The proportion of the number of each group of apophyses in the different species is synoptically shown in the following table:—

| | Depth in Fathoms. | Challenger Station. | Length of the Shell. | Breadth of the Shell. | Number of Feet. | Number of Pedal Pores. | Number of Teeth. | Number of Dental Pores. |
|---|---|---|---|---|---|---|---|---|
| 1. *Tuscarora bisternaria*, | 3000 | 264 | 2·0 | 1·5 | 3 | 8 | 3 | 8 |
| 2. ,, *murrayi*, | 2000 | 295 | 2·5 | 1·5 | 3 | 3 | 3 | 3 |
| 3. ,, *wyvillei*, | 2250 | 291 | 1·5 | 1·4 | 3 | 4 | 3 | 4 |
| 4. ,, *tetrahedra*, | 2450 | 348 | 2·5 | 2·0 | 3 | 4 | 3 | 3 |
| 5. ,, *tubulosa*, | 3000 | 249 | 1·4 | 1·2 | 3 | 4 | 2 | 3 |
| 6. ,, *porcellana*, | 2650 | 325 | 1·5 | 1·3 | 3 | 4 | 2 | 4 |
| 7. ,, *belknapii*, | 2025 | 293 | 2·5 | 1·5 | 3 | 3 | 4 | 2 |
| 8. *Tuscarusa medusa*, | 3125 | 253 | 1·2 | 1·0 | 4 | 4 | 2 | 2 |
| 9. *Tuscaridium cygneum*, | 3050 | 250 | 3·2 | 1·6 | 1 | 2 | 4 | 4 |
| 10. ,, *lithornithium*, | 3000 | 264 | 3·6 | 1·8 | 1 | 4 | 4 | 6 |

The base of the apophyses in all Tuscarorida is inflated, conical, and pierced by a small number of large ovate pores, the typical "basal pores," which occur also in the closely allied Circoporida. The number of these basal pores varies from two to eight, and is usually three or four; it never becomes in this family so great as in the Circoporida, where each circle of pores is often composed of sixteen to twenty-four or more basal pores. The number seems to be rather constant in each single species, as may be seen in the preceding Table. The pedal pores (on the base of the aboral feet) are usually larger than the dental pores (on the base of the circoral teeth). Their form is

usually irregularly ovate or triangular; their outer aperture is armed with spines or bristles, which are commonly larger than in the other parts of the apophyses.

The mouth of the shell varies in form, according to the number and arrangement of the teeth on its corners. It is therefore a narrow transverse fissure, with two broad opposite lips and two corners, in the bidental forms (Pl. 100, figs. 5, 7), triangular in the tridental species (figs. 1–4), quadrangular or square in the quadridental species, *Tuscarora belknapii* (Narr. Chall. Exp., *loc. cit.*, pl. A, fig. 15). The singular genus *Tuscaridium* (fig. 8) exhibits four teeth, which are nearly horizontally divergent in two pairs, a dorsal and a ventral pair (corresponding in position to the four feet of *Tuscarusa*, fig. 7); the mouth is here prolonged into a cylindrical, spinulate proboscis, which is curved towards the ventral face of the shell (fig. 8).

The *central capsule* of the Tuscarorida is kidney-shaped or spheroidal, scarcely half as large as the dark olive-green phæodium, which surrounds its anterior (oral) face. Usually the capsule and the phæodium together fill up the aboral half of the shell-cavity, and are separated from its walls by the calymma. The latter is pierced by numerous branched and reticulately anastomosing pseudopodia, which arise from the matrix enveloping the capsule, and pass over into a thin layer of sarcode, adjacent to the inner surface of the shell. The astropyle or the main-opening of the central capsule exhibits the usual radiate operculum and tubular proboscis of the PHÆODARIA (Pl. 115, fig. 3), and is directed towards the mouth of the shell. The number of the parapylæ or accessory openings seems to be variable in this family, and to correspond to the number of radial feet which arise from the shell. Therefore *Tuscaridium* possesses only one parapyle, which is diametrically opposite to the mouth, lies on the aboral pole of the capsule, and is directed towards the single caudal tube. *Tuscarora* seems to have three parapylæ, corresponding to the three radial feet, and *Tuscarusa* probably has four parapylæ, directed towards its four radial feet; in the latter genus, however, the capsule was not observed (the shell being empty); and in the other Tuscarorida this important and difficult anatomical question must be solved by further accurate examinations.

The nucleus is nearly half as large as the central capsule, ellipsoidal, and contains numerous nucleoli. In one specimen of *Tuscarora belknapii* I observed two nuclei in the central capsule, and in another specimen of the same species John Murray observed two central capsules (figured by him in the Narr. Chall. Exp., vol. i. pl. A, fig. 15).

*Synopsis of the Genera of Tuscarorida.*

| | |
|---|---|
| Three equidistant aboral radial feet, . . . . . | 717. *Tuscarora.* |
| Four equidistant aboral radial feet, . . . . . | 718. *Tuscarusa.* |
| One single aboral foot or terminal spine, . . . . . | 719. *Tuscaridium.* |

Genus 717. *Tuscarora*,[1] John Murray, 1876, *in schedulis*, Chall. Coll.

*Definition.*—Tuscarorida with three radial aboral feet, and a variable number of circoral teeth.

The genus *Tuscarora* comprises seven of the ten observed species of Tuscarorida, all seven agreeing in the possession of three perradial feet, which alternate originally (in four species), with three interradial teeth surrounding the mouth. The latter is armed in two other species with two teeth, and in one species with four teeth (compare above, p. 1704). The three perradial feet have a similar position as in the tripodal NASSELLARIA, so that they may be distinguished as an odd caudal foot and two paired lateral feet.

Subgenus 1. *Tuscarantha*, Haeckel.

*Definition.*—Shell with three perradial equidistant feet and three interradial equidistant circoral teeth, alternating regularly with the former.

1. *Tuscarora bisternaria*, John Murray (Pl. 100, figs. 1, 1*a*).

*Tuscarora bisternaria*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, figs. 16, 16*a*.

Shell subspherical, with three lateral perradial feet in the equatorial zone, and three basal interradial teeth around the mouth, alternating regularly with the former. The three lateral feet arise either in the equator itself or a little above it, and are nearly horizontally expanded, descending a little towards the aboral pole. They are straight, cylindrical, twice to four times as long as the shell, geniculate at the inflated base, and covered with small thorns. A circle of six to eight basal pores in the base of each foot. The narrow mouth is triangular, surrounded by the thorny, inflated, subspherical bases of the three long, cylindrical, diverging, thorny teeth, which ascend obliquely and are longer than the shell; each tooth exhibits in the upper part of the inflated base a corona of eight to ten ovate holes.

*Dimensions.*—Length of the shell 2·0, breadth 1·5.

*Habitat.*—Central Pacific, Station 264, depth 3000 fathoms.

2. *Tuscarora murrayi*, n. sp. (Pl. 100, fig. 2).

Shell pear-shaped, with three circoral perradial feet in the upper third and three basal interradial teeth around the mouth. The three lateral feet are thin, cylindrical, arcuate, very bristly, arise immediately beyond the narrow tubular peristome, and ascend obliquely nearly to the height of the mouth; then they are curved downwards in a large arc, three to four times as long as

[1] *Tuscarora*, named from the American ship "Tuscarora," commanded by Captain Belknap, which made a splendid series of deep-sea soundings in the Pacific Ocean in 1875.

the shell. The tubular peristome is about half as long as the shell, bottle-shaped, nearly three-sided prismatic, and bears three very long spinulate teeth, which in the lower half are parallel, in the upper slightly curved and diverging, at the base pear-shaped. Three ovate basal pores in the inflated base of each foot and each tooth.

*Dimensions.*—Length of the shell 2·5, breadth 1·5.

*Habitat.*—South Pacific, Station 295, depth 1500 fathoms.

### 3. *Tuscarora wyvillei*, n. sp. (Pl. 100, figs. 3, 3*a*–3*c*).

Shell subspherical, pellucid, thinner and more fragile than in the other species of the genus, with three aboral perradial feet in the lower third, and three interradial teeth around the wide mouth. The three feet are straight, conical, widely divergent, shorter than the shell, and arise from its lower third; on the inflated base of each four small ovate pores. The three teeth, alternating with them, are straight, cylindrical, arise from the margin of the mouth and diverge obliquely upwards. On the base of each foot four opposite cordate pores of very unequal size.

*Dimensions.*—Length of the shell 1·5, breadth 1·4.

*Habitat.*—South Pacific, Station 291, depth 2250 fathoms.

### 4. *Tuscarora tetrahedra*, John Murray (Pl. 100, figs. 4, 4*a*).

*Tuscarora tetrahedra*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 19.

Shell tetrahedral or three-sided pyramidal, with three perradial basal feet, and three alternate, interradial, circoral teeth. The three rounded edges of the pyramid are prolonged directly over the aboral base into the three short, divergent, conical, basal feet, which are smooth and scarcely one-fourth as long as the shell. The base of each foot is pierced by four small crossed pedal pores. The narrow mouth, on the apex of the pyramid, is surrounded by three short and broad, triangular, spinulate teeth, each of which bears three slender, triangular, dental pores.

*Dimensions.*—Length of the shell 2·5, breadth 2·0.

*Habitat.*—Tropical Atlantic, Station 348, depth 2450 fathoms.

## Subgenus 2. *Tuscaretta*, Haeckel.

*Definition*—Shell with three perradial equidistant feet, and with two circoral teeth, which are opposite in the radius of the odd dorsal foot; therefore a dorsal and a ventral tooth.

### 5. *Tuscarora tubulosa*, John Murray (Pl. 100, figs. 5, 5*a*, 5*b*).

*Tuscarora tubulosa*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 17.

Shell subspherical, with three lateral perradial feet on the upper half of the shell (above the equator), and two parallel vertical teeth on the mouth. The three feet arise between the upper and

the middle third of the shell, diverge upwards, and are slightly arcuate, covered with numerous curved spines. Their base is pierced by four pedal pores. The peristome is a narrow sagittal fissure, placed in the radius of the odd or dorsal foot, and bears two opposite teeth on its two corners. The teeth are cylindrical, longer than the shell, covered with curved spines, and ascend in a parallel and vertical manner; each is perforated at the base by three large dental pores.

*Dimensions.*—Length of the shell 1·4, breadth 1·2.

*Habitat.*—North Pacific, Stations 244 to 250, depth 2050 to 3050 fathoms.

### 6. *Tuscarora porcellana*, John Murray (Pl. 100, figs. 6*a*, 6*b*).

*Tuscarora porcellana*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., pl. A, fig. 18.

Shell pear-shaped, with three lateral perradial feet in the lower half of the shell, and two parallel vertical teeth on the mouth. The three lateral feet arise between the middle and the lower third of the shell, are straight, cylindrical, spinulate, about as long as the shell and diverge downwards; their base is pierced by four ovate pedal pores. The two parallel and vertical teeth are straight, shorter than half the shell, and opposite in the sagittal plane, on the two corners of the narrow mouth, in the radius of the dorsal odd foot. The base of each tooth exhibits four cordate dental pores.

*Dimensions.*—Length of the shell 1·5, breadth 1·3.

*Habitat.*—South Atlantic, Station 325, depth 2650 fathoms.

## Subgenus 3. *Tuscarilla*, Haeckel.

*Definition.*—Shell with three perradial equidistant feet, and with four crossed equidistant teeth around the mouth.

### 7. *Tuscarora belknapii*, John Murray.

*Tuscarora belknapii*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, figs. 15, 15*a*–15*d*.

Shell pear-shaped, with three lateral perradial feet in the upper third, and four crossed teeth around the mouth. The three arcuate feet are thin, cylindrical, covered with small curved thorns, and arise at the base of the peristome, between the upper and middle third of the shell; they ascend diverging to the height of the mouth, and are then curved downwards in a large arc, twice to three times as long as the shell. The base of each foot is dilated and pierced by three pedal pores. The four thin and long teeth of the peristome are similar to the feet, ascend in a slightly diverging manner, and are so placed that two opposite lie in the sagittal plane (or in the radius of the dorsal odd foot), whilst the two others are opposite in the frontal plane (perpendicular to the former). The base of each tooth exhibits two large ovate dental pores.

*Dimensions.*—Length of the shell 2·5, breadth 1·5.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

## Genus 718. *Tuscarusa*,[1] n. gen.

*Definition.*—Tuscarorida with four radial aboral feet and a variable number of circoral teeth.

The genus *Tuscarusa* differs from the preceding closely allied *Tuscarora* in the possession of four radial feet instead of three. The mouth of the single observed species is a narrow sagittal fissure, and armed with two opposite teeth (a dorsal and a ventral, as in the subgenus *Tuscaretta*). The four lateral feet form a cross, and lie opposite in pairs, in two diagonals of the square, which is bisected by the sagittal mouth.

### 1. *Tuscarusa medusa*, n. sp. (Pl. 100, figs. 7, 7*a*).

Shell ovate, with four crossed lateral feet in the upper third, and with two opposite teeth around the mouth. The four feet are opposite in pairs in two diameters of the shell, perpendicular one to another, and arise between the upper and middle third of the shell; they are thin, cylindrical, spinulate, arcuate, and ascend to the height of the mouth diverging upwards; then they are curved downwards in a large arc. They lie in the diagonals of the square, which is halved by the narrow and long fissure of the mouth. This lies in the original sagittal plane, and from its two corners arise the two opposite teeth (a dorsal and a ventral), diverging upwards, cylindrical and slightly curved. The base of each foot is pierced by four pedal pores, of each tooth by two dental pores.

*Dimensions.*—Length of the shell 1·2, breadth 1·0.

*Habitat.*—North Pacific, Station 253, depth 3125 fathoms.

## Genus 719. *Tuscaridium*,[2] n. gen.

*Definition.*—Tuscarorida without radial aboral feet, but with a terminal axial caudal foot, and a variable number of circoral teeth.

The genus *Tuscaridium*, comprising two closely allied species, differs from the two preceding genera of Tuscarorida in the absence of lateral radial feet, which are represented by a single large caudal spine placed in the main axis of the shell, at its aboral pole. The shell is therefore spindle-shaped, and not ovate or subspherical, as in the two other genera. It reaches in the two observed species a length of more than 3 mm.

### 1. *Tuscaridium cygneum*, Haeckel.

*Tuscarora cygnea*, John Murray, 1879, *in litteris*, Narr. Chall. Exp., vol. i. p. 226, pl. A, fig. 20.

Shell spindle-shaped, twice as long as broad (in the transverse section circular), equally tapering towards both poles of the main axis. The aboral pole bears a thin, cylindrical, straight, caudal

[1] *Tuscarusa*, derivation from *Tuscarora*.

[2] *Tuscaridium*, derivation from *Tuscarora*.

spine, placed in the prolongation of the main axis, and about half as long as the shell. Its base is pierced by two large opposite pedal pores. The anterior or oral pole bears a cylindrical peristome, similar to a bird's head, and curved towards the ventral face; on both sides of its neck (at right and left) a series of three or four irregular, ovate, buccal holes. The neck bears four cylindrical, spinulate, radial tubes (two on each side), crossed nearly horizontally, and placed in two diagonal planes perpendicular one to another; these planes correspond to those in which the four feet of *Tuscarusa medusa* lie. The base of each tube is pierced by four dental pores.

*Dimensions.*—Length of the shell 3·2, breadth 1·6.

*Habitat.*—North Pacific, Station 250, depth 3050 fathoms.

2. *Tuscaridium lithornithium*, n. sp. (Pl. 100, figs. 8, 8*a*, 8*b*).

Shell spindle-shaped, twice as long as broad, very similar to the preceding closely allied species. It differs from the latter in the following characters:—The curved proboscis of the peristome is broader and more spiny. The four radial tubes of the mouth and the terminal caudal spine are very spiny (in the preceding species nearly smooth). The number of buccal holes (six to eight on each side of the mouth) is twice as great as in the former. Each circoral tube is pierced at the base by six or eight (in the former by four pores), and the base of the caudal spine exhibits a cross of four pores (in *Tuscaridium cygneum* only two pores).

*Dimensions.*—Length of the shell 3·6, breadth 1·8.

*Habitat.*—North Pacific, Station 264, depth 3000 fathoms.

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## Order IV. PHÆOCONCHIA, Haeckel, 1879.

*Definition.*—PHÆODARIA with a bivalved lattice-shell, composed of two free opposite valves (a dorsal and a ventral), between which the central capsule is enclosed.

### Family LXXXIII. CONCHARIDA, Haeckel, 1879 (Pls. 123–125).

*Concharida*, Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—PHÆODARIA with a bivalved lattice-shell, which is spherical or lenticular, and composed of two equal or unequal boat-shaped valves, a dorsal and a ventral. The valves bear neither an apical latticed cupola or galea, nor hollow radial tubes. The central capsule is placed in the aboral half of the shell-cavity, and so enclosed between both valves, that its three openings lie in the open frontal fissure between them (the astropyle on the oral pole of the main axis, the two parapylæ on both sides of its aboral pole, at right and left).

The family Concharida and the two following closely allied families, the Cœlodendrida and Cœlographida, compose together the most remarkable and interesting suborder of Phæoconchia (or "PHÆODARIA bivalva"), differing from all the other Radiolaria in the possession of a bivalved lattice-shell, composed of two separate valves, like the shell of a Brachiopod. The central capsule is so enclosed between the two fenestrated valves that its three openings lie in the horizontal open (frontal) fissure between them, the astropyle or main-opening on the oral pole of the main axis; the two secondary openings or parapylæ on the two sides of its aboral pole, at right and left. The plane in which the three openings lie is therefore the frontal plane, dividing the entire body into a dorsal and a ventral half. The two valves, accordingly, must be considered as dorsal and ventral valves (as in the Brachiopoda), and the symmetrical halves of each valve as right and left. These halves may be always easily distinguished, since the oral pole of each valve is constantly different from the aboral pole. The voluminous phæodium always lies in the oral half, and the central capsule in the aboral half of the shell-cavity, whilst the calymma encloses the whole shell.

The Concharida differ from the other two families of bivalved PHÆODARIA in the absence of the apical galeas, and the branched hollow tubes arising from them. Each of these two cupolas, which are at the opposite poles of the sagittal axis (one cupola on the apex of each valve), is in the Cœlographida connected by a simple or double frenulum with a peculiar rhinocanna, or an open nasal tube directed towards the mouth; whilst the cupolas of the Cœlodendrida possess neither a rhinocanna nor a frenulum. The three families of Phæoconchia may therefore represent a phylogenetical series, the common root of which are the Concharida. From these are developed the Cœlodendrida by development of an apical cupola or galea on each valve, and of hollow radial tubes arising from it; whilst the Cœlographida are developed from the latter by production of a rhinocanna on the base of each cupola, and of one or two frenula connecting the former with the latter.

All the Concharida described in the following pages (seven genera and thirty species), are perfectly new to science, and not a single form of this interesting family was known before the explorations of the Challenger. Some species (mainly of the genera *Conchidium* and *Conchopsis*) are by no means rare, and are found in great numbers at some stations of the tropical seas (in the Pacific as well as in the Atlantic). All described species are closely allied, agree in the majority of characters, and are easy to distinguish from all the other Radiolaria. Some few forms of Concharida, however, form a direct passage to the Cœlodendrida.

Regarding the probable origin of the Concharida (and therefore also of all other Phæoconchia derived from the latter), two different hypotheses are possible. They have either been derived directly from the skeletonless *Phæodina*, by development of a bivalved lattice-shell; or they may be derived from PHÆODARIA with a simple

spherical lattice-shell (Castanellida), by the halving of this latter, or its splitting into two hemispherical valves; the former hypothesis is more probable than the latter.

The two valves of the lattice-shell (Pls. 123–126) must in the Concharida (as in all other Phæoconchia) be distinguished as dorsal and ventral, and may therefore be compared with the two valves of the Brachiopoda, not with those of the Lamellibranchia. This important morphological distinction is expressed by the constant position of the central capsule within the shell-cavity. The capsule always exhibits the character of the "TRIPYLEA" and has three tubular openings, placed in the frontal or lateral plane of the unicellular body. In the same plane lies the open frontal fissure between the two valves, and the three openings are so disposed in it that the large anterior main-opening (or the astropyle) is placed on the oral pole of the main axis, whilst the two accessory small lateral openings or parapylæ are placed on both sides of the aboral pole, at the right and left. Therefore in a dorsal or ventral view all three openings are visible (Pl. 123, figs. 1, 8*a*); in the usual lateral view, however, from the right or left side, only two openings are visible, the astropyle on the anterior, and one parapyle (right or left) near the posterior pole of the main axis (Pl. 123, figs. 8, 9; Pl. 124, figs. 6, 10). The posterior view (from the aboral pole) shows the two parapylæ, at right and left; in the anterior view (from the oral pole) the astropyle may be visible, but usually it is completely hidden in the dark voluminous phæodium. This latter envelops sometimes nearly the whole capsule as an opaque conglomeration of green or brown phæodella (Pl. 123, figs. 8, 9); but usually the phæodium fills up the anterior (oral) half of the shell-cavity, whilst the capsule occupies the posterior (aboral) half (Pl. 124, figs. 6, 10).

The dorsal shell-valve is in almost all PHÆODARIA smaller or somewhat different in shape from the ventral valve, and this difference is often very striking (Pl. 124, figs. 3–16); but in a few species both valves are so similar, that I could not discover any certain difference. This equality of the two valves occurs mainly in those Concharida which pass over into the Cœlodendrida; in these latter as well as in the Cœlographida, both valves are usually equal in size and form. Whilst the main axis (or the longitudinal axis of the body) in the two latter families of Phæoconchia seems to be normally vertical (in the living and freely floating body), in the living Concharida it is probably horizontal, so that the larger and heavier ventral valve lies below the smaller and lighter dorsal valve.

The geometrical fundamental form of the body is therefore in the Concharida dipleural or bilaterally symmetrical, and we distinguish in it the same three dimensive axis, as in all other dipleural forms. On the anterior or oral pole of the main axis (or longitudinal axis) lies the mouth of the shell, and behind it the phæodium; on the opposite posterior or aboral pole lies the hinge of the shell (comparable to the shell-hinge of the Brachiopoda) and in front of it the central capsule. The sagittal (or dorso-

ventral) axis, determining the height of the shell, has on its dorsal (or upper) pole the apex or highest point of the dorsal valve, on its ventral (or lower) pole the apex or lowest point of the ventral valve. The two poles of the frontal (lateral or transverse) axis are equal and are determined by the two parapylæ of the capsule, and the corresponding points of the shell-fissure between both valves. Usually the main-axis is the longest, the frontal axis the shortest, and between both the sagittal axis.

In regard to the three dimensive planes which are determined by these three axes, perpendicular to one another, they are rarely of nearly equal size (as in some subspherical species), usually the sagittal plane (separating the right and left halves of the body) is the largest; the cinctural or equatorial plane (separating oral and aboral halves) is the smallest, and the frontal or lateral plane (separating dorsal and ventral halves) is intermediate in size. The relation of the three perimeters of these three planes corresponds to that proportion; the sagittal perimeter (in which the keel of the compressed valves lies) is the largest; the cinctural or equatorial perimeter (separating the anterior phæodium and the posterior central capsule) is the smallest, and the frontal or lateral perimeter (in which the fissure between the valves lies) is intermediate in size.

The general form of the single valves is very varied in the different species, in the majority boat-shaped or hat-shaped, more or less laterally compressed, in a few forms hemispherical. In *Conchopsis* (Pl. **125**) and *Conchoceras* (Pl. **124**, figs. 15, 16) the lateral parts of the valves (right and left) are vaulted, whilst their median parts are so strongly compressed that they form a sharp sagittal keel, and then the shell in the dorsal or ventral view appears spindle-shaped (Pl. **123**, fig. 8*a*; Pl. **125**, fig. 8). Often the frontal margins of the valves are somewhat constricted (Pl. **124**, fig. 7).

The junction between the two valves of the shell is always loose, but not so loose as in the two following families. In the Cœlodendrida and Cœlographida the two valves are either perfectly free and separated by a frontal zone of jelly, or in very loose contact on the frontal margins. In the Concharida, however, the margins of both valves seem to be usually in contact, and their connection is effected in a double way. In the subfamily Conchasmida (comprising the genera *Concharium* and *Conchasma*, Pl. **123**, figs. 1–6) the lateral margins of both valves are smooth, not dentated, and fit one into another like the two parts of a box, or like the two valves of a Diatom (*Navicula*). In the second subfamily, however, Conchopsida (comprising the five other genera, Pls. **124**, **125**), the lateral margins of the valves are dentate, usually provided with a series of numerous strong conical teeth, and the teeth of both valves so catch into one another, that their union is rather firm (like the margin of the shells of *Tridacna*, *Pecten*, and other Lamellibranchiata). Besides, a more solid junction is often effected on the posterior or aboral part of the margins, which we shall call the hinge. Here often peculiar strong teeth catch one into another, and in the majority of species

two aboral spines are developed, the caudal horns (a dorsal and a ventral); these are very large in *Conchoceras* (Pl. **124**, figs. 15, 16). But a peculiar and most interesting kind of junction is effected in some Concharida by a true ligament between the valves (Pl. **123**, figs. 8, 9; Pl. **125**, fig. 2). This ligament is always placed on the aboral hinge, is of dark brown colour, and is not dissolved by mineral acids unless long applied. It may preserve the connection of the posterior parts of both valves, when their anterior parts are removed one from another, just as in the Brachiopoda. I observed this interesting ligament mainly in the genus *Conchopsis*, but not in all species, and it is not yet certain whether it is a constant organ in these and some other Concharida.

In the majority of Concharida the lateral margins of the two valves project slightly inwards into the cavity, and in some species of *Conchopsis* these inner borders are so broadened that they form a broad, horizontal, fenestrated inner shelf, comparable to the deck of a boat or to the velum of the Hydromedusæ or Craspedotæ (Pl. **125**, fig. 9). In this case the velum surrounds the ovate aperture through which the two lobes of the central capsule (dorsal and ventral) enter into the cavity of both valves.

The mouth of the shell lies on the oral pole of the main axis, and is therefore opposed to the aboral hinge. The two valves are here usually more or less emarginate, so as to form a transverse mouth with an upper and a lower lip (Pl. **124**, figs. 6, 7, 11). The form of these two lips is often very different and characteristic of particular species (Pl. **124**, figs. 3, 15, 16). The mouth remains in many species constantly open, even when the frontal fissure is closed (figs. 7, 16). Since the centre of the shell mouth lies in the prolongation of the proboscis arising from the operculum of the central capsule, probably the main stream of sarcode, issuing from the latter, becomes protruded by the former.

Apophyses of the shell (besides the teeth of the margins) are completely wanting in three genera, *Concharium*, *Conchellium*, and *Conchopsis* (Pl. **123**, figs. 1–4, 7; Pl. **125**). The four other genera possess free apophyses or spines, which we call horns. They are probably important as the beginnings of those large hollow tubes which are characteristic of the two following families, Cœlodendrida and Cœlographida. We distinguish two different forms of horns, apical horns on the poles of the sagittal axis, and caudal horns on the aboral pole of the main axis; the former probably correspond to the sagittal tubes and the latter to the caudal tubes of the two following families. Apical horns are found in a single genus only, *Conchonia* (Pl. **124**, figs. 10–14). Here either on one pole or on both poles of the sagittal axis a horn is developed, usually curved backwards. Sometimes the base of this conical horn is inflated and fenestrated, and may represent the beginning of the formation of the galea or apical cupola of the Cœlodendrida.

The two caudal horns are opposite on the aboral hinge of the shell, one arising from the posterior end of each valve. Usually they are short and thick, pyramidal, the

ventral horn larger than the dorsal (Pl. 124, figs. 3, 6). Rarely the two caudal horns are fenestrated at the base and reach a considerable size, as in *Conchoceras* (Pl. 124, figs. 15, 16).

The walls of the bivalved shell usually exhibit in the Concharida a rather solid shape and regular structure, with an elegant network of regularly arranged pores. But in some species the walls of the shell become very thin and fragile, and assume the same shape (with very irregular network), as in the Cœlodendrida and Cœlographida. The pores are usually small and numerous, circular, often hexagonally framed (Pl. 125, figs. 4–6). They pierce the thick shell-wall either in a radial or in an oblique direction. Sometimes each pore is armed with six radial teeth (Pl. 123, fig. 7*a*). At other times each pore represents an oblique ampullaceous canal, dilated in its middle part, with two narrow openings (Pl. 125, figs. 5*a*, *b*, *c*, 6). The pores are so arranged in the majority of species that they form regular curved series, which are separated by prominent crests, and converge towards the poles of the main axis. Usually the marginal pores (along the frontal margins of the valves) are much smaller (compare Pls. 123–125).

The *central capsule* of the Concharida, very well preserved in numerous specimens of the Challenger collection, constantly possesses the same situation and structure. It is always enclosed in the aboral or posterior half of the shell-cavity, whilst the oral or anterior half is filled up by the phæodium. The free spaces between both and between the inner surface of the shell are completely filled up by the jelly of the calymma, which also covers the whole shell as a thin outer jelly-envelope. The form of the central capsule is sometimes nearly spherical, usually somewhat compressed in the direction of the main axis, and sometimes also in the direction of the frontal axis (Pl. 123, figs. 1–9). In some species it becomes bilobed, with an upper dorsal and a lower ventral lobe, and in some others it becomes triangular (Pl. 125, fig. 7). Its two membranes (inner and outer) are often separated by a broad colourless interval, containing a clear fluid or jelly (Pl. 123, figs. 8, 9). The nucleus is usually about half as large as the central capsule and ellipsoidal, its longer axis lying in the sagittal diameter of the body. Several specimens (of different genera) contained two separate nuclei, one placed in the dorsal, the other in the ventral half of the capsule (Pl. 124, fig. 6). This duplication of the nucleus is probably the preparation for the division of the capsule. The division will be probably effected in the frontal plane, so that each half of the bisected capsule gets one nucleus and one valve, and the other valve becomes newly formed (in a way similar to that in the bivalved Diatomaceæ). The astropyle, or the main-opening of the capsule, is closed by a radiate operculum, from which arises a tubular proboscis; this lies in the main axis of the body, is directed towards the anterior mouth of the shell, and surrounded by the phæodium. The two shorter tubes of the paired parapylæ, or the accessory lateral openings, lie on the posterior or caudal side of

the capsule, at right and left, and are directed half backwards, half outwards (towards the frontal fissure between the valves, Pl. **123**, figs. 1, 8*a*).

The phæodium exhibits in all Concharida the same characteristic shape, and represents a dark conglomeration of phæodellæ, filling up the anterior or oral half of the shell-cavity. Usually it is bilobed, divided into a dorsal and a ventral lobe or wing, which fills up the corresponding valve of the shell (Pl. **123**, figs. 8, 9). The phæodium is commonly more voluminous than the capsule, and surrounds its anterior half, more rarely it encloses nearly the entire capsule (Pl. **124**, figs. 6, 10). Its colour is usually olive, sometimes more greenish, at other times more brownish, in some species nearly black. The phæodellæ, or the roundish granules which compose the phæodium, exhibit the same shape as in all other PHÆODARIA (compare above, p. 1535). Sometimes peculiar rather oblong nucleated cells are scattered in great numbers between the phæodellæ, probably parasites or symbiontes (Pl. **123**, figs. 7–9, 9*a*).

*Synopsis of the Genera of Concharida.*

| | | | | |
|---|---|---|---|---|
| I. Subfamily Conchasmida. Lateral edges of the two valves smooth, without teeth. | Valves without sagittal keel, nearly hemispherical or slightly compressed. | Aboral hinge without horns, | 720. | *Concharium.* |
| | | Aboral hinge with two horns (one on each valve), | 721. | *Conchasma.* |
| II. Subfamily Conchopsida. Lateral edges of the two valves dentate, with a series of prominent teeth on both sides. The teeth of both valves catch one into another. | Valves without sagittal keel, nearly hemispherical or slightly compressed. | Aboral hinge without horns, | 722. | *Conchellium.* |
| | | Aboral hinge with two horns. No apical horn, | 723. | *Conchidium.* |
| | | Aboral hinge with two horns. Apex also with a horn, | 724. | *Conchonia.* |
| | Valves with a sharp sagittal keel, strongly compressed on both sides, boat-shaped. | Aboral hinge without horns, | 725. | *Conchopsis.* |
| | | Aboral hinge with two horns (one on each valve). | 726. | *Conchoceras.* |

## Subfamily 1. CONCHASMIDA, Haeckel.

*Definition.*—Concharida with the lateral margins of the two valves smooth, without interlocking teeth.

### Genus 720. *Concharium*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Concharida with the lateral margins of the valves smooth, without sagittal keel and without horns on the hinge.

[1] *Concharium*=Small mussel; κογχάριον.

The genus *Conchariun* is the simplest and the most primitive form of all Concharida; it may be regarded as the common ancestral form of the whole family. The entire shell is usually almost spherical, without horns or teeth, and may be regarded as a *Castanella* which is bisected or broken into two equal hemispherical halves. The lateral margins of the two hemispherical valves are smooth, without teeth, and catch one into the other like the two valves of a Diatom, or the two halves of a bivalved box. *Conchariun* agrees in this simple shape of the frontal margins with the following genus *Conchasma*, and represents with it the small subfamily Conchasmida.

1. *Conchariun bivalvum*, n. sp. (Pl. 123, figs. 2, 2*a*).

Shell spherical, smooth. Diameter in all directions nearly the same. Borders of the two hemispherical valves circular, smooth, about twice as broad as the pores. In the half frontal perimeter of the shell (along the right and the left border of each valve) twenty-two to twenty-four pores, in the half sagittal perimeter (in the middle line of each valve) eighteen to twenty-two pores, in the half equator (in the cinctural perimeter of each valve) twenty to twenty-two pores. All pores circular, of the same size, twice as broad as their bars.

*Dimensions.*—Length of the shell (longitudinal diameter) 0·35, height (sagittal diameter) 0·34, breadth (lateral diameter) 0·33.

*Habitat.*—North Atlantic, west of Madeira, Station 354, depth 1675 fathoms.

2. *Conchariun nucula*, n. sp. (Pl. 123, fig. 3).

Shell pear-shaped, with costate surface. Oral face somewhat truncated, broader than the aboral face. Its longitudinal diameter about one-fifth longer than the two other diameters. Borders of the two valves ovate, smooth, about as broad as the pores. In the half frontal perimeter of the shell twenty-two to twenty-four pores, in the half sagittal perimeter eighteen to twenty, in the half equator sixteen to eighteen. Pores irregularly roundish, three to four times as broad as the bars. The pores are so disposed in meridional rows that the crests between the rows converge towards the two poles of the sagittal axis.

*Dimensions.*—Length of the shell 0·2, height 0·18, breadth 0·16.

*Habitat.*—South Atlantic (west of Tristan da Cunha), Station 332, depth 2200 fathoms.

3. *Conchariun diatomeum*, n. sp. (Pl. 123, fig. 1).

Shell nearly spherical, slightly lenticular, somewhat compressed in dorso-ventral direction; the sagittal diameter therefore somewhat shorter than the two others. Borders of the two hemispherical valves nearly circular, quite smooth, about as broad as the length of the largest pores. In the half frontal perimeter of the shell forty-four to fifty pores; in the half sagittal perimeter twenty to twenty-four; in the half equator thirty to thirty-three. Pores different in form and size; the

marginal pores small, nearly circular; the dorsal and ventral pores oblongish-hexagonal, twice as long as broad, about four to six times as long as the bars, regularly arranged in transverse rows.

*Dimensions.*—Length of the shell 0·22, height 0·21, breadth 0·2.

*Habitat.*—Tropical Atlantic, near Sierra Leone, Station 348, depth 2450 fathoms.

### 4. *Concharium bacillarium*, n. sp. (Pl. 123, fig. 4).

Shell walnut-shaped, with panelled surface; oral and aboral face of the same form. Its longitudinal diameter about one-fifth longer than the two other diameters. Borders of the two cup-shaped valves elliptical, smooth, with a prominent edge, about as broad as the larger pores. In the half frontal perimeter of the shell fifty to fifty-five pores, in the half sagittal perimeter thirty-six to forty, in the half equator also thirty to forty. Pores hexagonally framed. The pores are tapering in size from the sagittal plane towards the valve-margins, and so regularly arranged in meridional rows that the crests between the latter converge towards both poles of the longitudinal axis.

*Dimensions.*—Length of the shell 0·2, height 0·15, breadth 0·15.

*Habitat.*—Tropical Atlantic, off St. Helena, Station 340, depth 1500 fathoms.

### 5. *Concharium fragilissimum*, n. sp.

Shell subspherical, very thin-walled and fragile. Diameter in all directions nearly the same. Oral and aboral face scarcely different. Margins of the hemispherical valves extremely thin and hyaline. Pores irregularly roundish, of very different sizes and unequal forms. The fragile shell of this species differs in general shape from that of all other Concharida, and is like that of the Cœlodendrida (Pl. 121, fig. 3), but exhibits neither an apical cupola or galea, nor radial tubes arising from it. It may be perhaps a young specimen of *Cœlodendrum*.

*Dimensions.*—Diameter of the shell 0·22, of the pores 0·002 to 0·02.

*Habitat.*—Mediterranean, Portofino (Haeckel), surface.

## Genus 721. *Conchasma*,[1] n. gen.

*Definition.*—Concharida with the lateral margins of the valves smooth, without sagittal keel, but with two caudal horns on the hinge (a dorsal and a ventral).

The genus *Conchasma* is closely allied to the preceding *Concharium*, and has the same hemispherical valves with smooth margins, without teeth; but it differs from the latter in the development of two caudal horns or posterior spines on the aboral hinge, one horn on the aboral end of each valve. The three species of this genus were all found in great depths of the Antarctic Ocean, in Diatom ooze, between 1260 and 1975 fathoms, at Stations 152 to 157.

[1] *Conchasma* = Bivalved shell-fish; κογχάσμα.

1. *Conchasma radiolites*, n. sp. (Pl. 123, fig. 5).

Shell nearly spherical, somewhat compressed on both sides; the dorsal valve smaller, flatter and shorter than the ventral valve. In the half sagittal perimeter of the shell twenty to twenty-two pores, in the half frontal perimeter twelve to fourteen, in the half equator eighteen to twenty. All pores nearly of the same size, circular, hexagonally framed, scarcely as broad as the bars. The two horns of the hinge are four-sided pyramidal, of different sizes; the ventral horn (of the larger valve) two to three times as long as the dorsal horn (of the smaller valve); the latter twice as long as a pore.

*Dimensions.*—Length of the shell 0·16, height 0·15, breadth 0·14.

*Habitat.*—Antarctic Ocean, Station 154, depth 1800 fathoms.

2. *Conchasma sphærulites*, n. sp. (Pl. 123, fig. 6).

Shell nearly spherical, somewhat compressed on both sides, the frontal diameter therefore somewhat shorter than the two others. Both valves nearly of the same size, hemispherical, their borders smooth, twice as broad as the largest pores. In the half sagittal perimeter of the shell twenty-eight to thirty pores, in the half frontal perimeter twenty to twenty-two, in the half equator twenty-four to twenty-six. Size of the pores increasing from the borders towards the top of the valves. One series of very small pores along the frontal free margin of each valve. Pores roundish-polygonal, three to four times as broad as the bars. The two horns of the hinge are of equal size, four-sided pyramidal, and twice as long as the larger pores.

*Dimensions.*—Length of the shell 0·18, height 0·18, breadth 0·16.

*Habitat.*—Antarctic Ocean, Station 152, depth 1260 fathoms.

3. *Conchasma hippurites*, n. sp.

Shell nearly spherical, scarcely compressed. The frontal diameter equal to the two others. Both valves equal. In the half sagittal perimeter of the shell thirty-two to thirty-four pores, in the half frontal perimeter twenty-four to twenty-six, in the half equator twenty-six to twenty-eight. All pores of nearly equal size, circular, polygonally framed, twice as broad as the bars. The two horns of the hinge are large, three-sided pyramidal, the ventral horn twice as long as the dorsal, and four to six times as long as one pore.

*Dimensions.*—Length of the shell 0·22, height 0·21, breadth 0·2.

*Habitat.*—Antarctic Ocean, Station 157, depth 1950 fathoms.

## Subfamily 2. Conchopsida, Haeckel.

*Definition.*—Conchar i da with the lateral margins of the two valves dentate, the teeth of both catch one into another.

## Genus 722. *Conchellium*,[1] n. gen.

*Definition.*—Concharida with the lateral margins of the valves dentate, without sagittal keel and without horns on the hinge.

The genus *Conchellium* and the four following genera represent together the subfamily Conchopsida, differing from the Conchasmida in the dentate lateral margins of the two valves. These are armed with a series of strong, conical teeth, and catch one into another just as the two valves of many Lamellibranchiata and Brachiopoda do (Pl. **124**, figs. 1–16). *Conchellium* is the simplest form among the Conchopsida, since the valves are hemispherical, and possess neither a sagittal keel nor projecting horns.

### 1. *Conchellium tridacna*, n. sp. (Pl. **123**, figs. 7, 7*a*).

Shell nearly spherical, finely tuberculated, the sagittal diameter somewhat longer than the two others. Borders of the two hemispherical valves smooth in 0·2 of the oral, and 0·1 of the aboral part, dentated in the remaining 0·7 part; on one side of each valve fourteen to sixteen very strong and long teeth, all nearly of the same size, about one-fourth as long as the shell-radius. In the half frontal perimeter of the shell (on one border of each valve) twenty-five to thirty pores, in the half sagittal perimeter thirty-five to forty, in the equator twenty-five to thirty. Pores circular, hexagonally framed, of equal size (except some smaller rows along the fissure), twice as broad as the bars. On the conical inside of each funnel-like pore six small spinules, between every three neighbouring pores a triangular facette (fig. 7*a*).

*Dimensions.*—Length of the shell 0·34 to 0·38, height 0·38 to 0·42, breadth 0·32 to 0·36.

*Habitat.*—North Pacific, Stations 250 to 253, depth 2740 to 3125 fathoms.

### 2. *Conchellium hippopus*, n. sp.

Shell nearly spherical, in the lateral perimeter (along the girdle-fissure) somewhat constricted. Borders of the two hemispherical valves semicircular, smooth in 0·3 of the oral, and 0·2 of the aboral part, dentated only in the remaining 0·5 middle part; on one side of each valve seven to eight very strong and long teeth, increasing in size towards the mouth, the longest (foremost) teeth nearly one-third as long as the shell-radius. In the half frontal perimeter of the shell (along one border of each valve) twenty-four to twenty-eight pores, in the half sagittal perimeter thirty-two to thirty-six, in the half equator twelve to fourteen. Pores circular, twice to three times as broad as the bars, smaller along the fissure.

*Dimensions.*—Length of the shell 0·06, height 0·065, breadth 0·055.

*Habitat.*—Central area of the Tropical Pacific, Station 274, depth 2750 fathoms.

[1] *Conchellium* = Small bivalved mussel; κογχύλλιον.

Genus 723. *Conchidium*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Concharida with the lateral margins of the valves dentate, without sagittal keel and apical horns, but with two caudal horns on the hinge (a dorsal and a ventral).

The genus *Conchidium* is the most common form of all Concharida, and some of its species occur in great numbers in the tropical zone of the Pacific and the Atlantic, on the surface as well as at various depths. It differs from the preceding *Conchellium*, its ancestral form, in the development of two caudal horns, or two strong pyramidal spines which arise from the posterior end of the valves; the dorsal horn usually is smaller than the ventral.

1. *Conchidium terebratula*, n. sp. (Pl. 124, figs. 1, 2).

Shell subspherical, smooth; both valves of nearly equal size and form, hemispherical. The three dimensive axes of the body are almost equal. Margins of the valves dentate in nearly the whole periphery; on each side of one valve eleven or twelve strong conical teeth, all of the same size. Aboral hinge with two short and stout four-sided pyramidal horns of equal length. Mouth with two equal short lips. Pores of the shell subregular, circular, three to four times as broad as the bars, in the dorsal valve twice as large as in the ventral valve.

*Dimensions.*—Diameter of the shell 0·24 to 0·28.

*Habitat.*—Central Pacific, Stations 270 to 274, surface, and at various depths.

2. *Conchidium thecidium*, n. sp. (Pl. 124, fig. 6).

Shell subspherical, slightly compressed on both sides. Dorsal valve somewhat smaller than the ventral, of similar form. Principal axis of the shell somewhat longer than the sagittal, and this longer than the frontal axis. Margins of the valves smooth in the oral quarter, strongly dentate in the remainder; on each side of one valve eight or nine very large triangular teeth, half as long as the height of the valve. Aboral hinge with two unequal, stout, four-sided pyramidal horns; the dorsal horn half as long at the ventral. Mouth with two unequal lips, the upper shorter than the lower. Pores of the shell subregular, hexagonal, three to four times as broad as the bars. The figured specimen, well preserved, contained in the central capsule two nuclei, one in the dorsal, the other in the ventral half.

*Dimensions.*—Length of the shell 0·28 to 0·33, height 0·27 to 0·3, breadth 0·22 to 0·24.

*Habitat.*—South Pacific, Station 292, depth 1600 fathoms.

[1] *Conchidium* = Similar to a bivalved mollusc; κογχίδιον.

### 3. *Conchidium rhynchonella*, n. sp. (Pl. 124, fig. 3).

Shell with three different dimensive axes in the proportion = 6 : 5 : 4. Ventral valve semi-ovate, larger than the humpbacked dorsal valve. Margins of the valves dentate almost in the whole periphery; on each side of one valve twelve or thirteen strong conical teeth. Aboral hinge with two very unequal horns, the dorsal much smaller than the pyramidal ventral. Under lip of the mouth emarginate, much larger than the acute upper lip. Pores subregular, circular, twice as broad as the bars.

*Dimensions.*—Length of the shell 0·3, height 0·25, breadth 0·2.

*Habitat.*—North Pacific, Stations 244 to 253, surface, and at various depths.

### 4. *Conchidium dimerella*, n. sp.

Shell laterally compressed, very similar to the preceding, but differing in the following characters:—Proportion of the three axes = 7 : 5 : 4. Ventral valve hemispherical, larger than the humpbacked dorsal. Margins of the valves dentate in the middle half only, whilst the anterior and posterior quarters are smooth; on each side of one valve six or seven strong conical teeth. Ventral horn of the aboral hinge very large, pyramidal, one-third as long as the shell and three times as long as the dorsal.

*Dimensions.*—Length of the shell 0·35, height 0·25, breadth 0·2.

*Habitat.*—North Pacific, Station 236, surface.

### 5. *Conchidium leptæna*, n. sp. (Pl. 124, figs. 4, 5).

Shell laterally compressed, with three different dimensive axes of the proportion = 4 : 3 : 2. Ventral valve larger than the dorsal, both semi-ovate. Margins of the valves dentate along the lateral sides; on each side of one valve nine or ten conical teeth, the middle of which are smaller. Aboral hinge with two unequal short horns; the dorsal rudimentary. Under lip of the mouth pointed, much larger than the truncate upper lip. Pores circular, about twice as broad as the bars.

*Dimensions.*—Length of the shell 0·2, height 0·15, breadth 0·1.

*Habitat.*—Central Pacific, Stations 271 and 272, surface, and at various depths.

### 6. *Conchidium argiope*, n. sp. (Pl. 124, figs. 7–9).

Shell laterally compressed, with three different dimensive axes of the proportion = 6 : 5 : 3. Both valves nearly equal. Margins of the shell dentate along the lateral fissure, on each side of one valve thirteen or fourteen thin conical teeth. Aboral hinge with two equal, short, pyramidal horns. Mouth with two equal short lips. Pores subregular, circular, twice as broad as the bars.

*Dimensions.*—Length of the shell 0·2, height 0·17, breadth 0·1.

*Habitat.*—Tropical Atlantic, Stations 341 to 349, surface, and at various depths.

7. *Conchidium magasella*, n. sp.

Shell laterally compressed, with two equal valves, very similar to the preceding species, but differing in the following characters:—Proportion of the three axes = 6 : 4 : 3. Margins of the valves with smaller and more numerous teeth; on each side of one valve sixteen to eighteen short conical teeth. Pores smaller and more numerous, about as broad as the bars.

*Dimensions.*—Length of the shell 0·24, height 0·16, breadth 0·12.

*Habitat.*—Indian Ocean, Madagascar (Rabbe), surface.

8. *Conchidium productum*, n. sp.

Shell laterally compressed, prolonged, with two equal valves, similar to the two preceding species, differing in the following characters:—Proportion of the three axes = 3 : 2 : 1. Margins of the valves smooth in the anterior and posterior quarter, dentate in the middle lateral half; on each side of one valve ten to twelve strong conical teeth. Horns of the aboral hinge prolonged, conical, half as long as the shell, the ventral somewhat larger than the dorsal. Pores regular, circular, twice as broad as the bars.

*Dimensions.*—Length of the shell 0·25, height 0·15, breadth 0·08.

*Habitat.*—North Atlantic, Station 354, surface.

## Genus 724. *Conchonia*,[1] n. gen.

*Definition.*—Concharida with the lateral margins of the valves dentate, without sagittal keel, but with an apical horn on the poles of the sagittal axis, and with two caudal horns on the hinge (a dorsal and a ventral).

The genus *Conchonia* is closely allied to the preceding *Conchidium*, its ancestral form, but differs from this and from all other Concharida in the development of horns on the poles of the sagittal axis. These are probably of great morphological importance, since they represent the beginnings of the hollow tubes arising from the poles of the sagittal axis in all Cœlodendrida and Cœlographida. In one of the three observed species each valve possessed an apical or sagittal horn, whilst in the two other species one valve only was provided with a horn. Since I observed one specimen only of each species, I cannot say whether this difference is important and of constant generic value.

1. *Conchonia diodon*, n. sp. (Pl. 124, figs. 10–12).

Shell laterally compressed, with two very unequal valves. Dorsal valve smaller, hat-shaped, on the apex with a fenestrated protuberance which is similar to the galea of the Cœlodendrida, and bears a short, conical, backwardly-directed horn. Ventral valve larger, boat-shaped, without apical

[1] *Conchonia* = Bivalved shell like a mussel; κόγχη, ὄνια.

horn. Aboral hinge with two pyramidal, horizontal, caudal horns of different sizes, the dorsal smaller than the ventral. Lateral margin of each valve on one side with twelve to fourteen strong conical teeth (fig. 12). Lips of the narrow mouth thickened (fig. 11).

*Dimensions.*—Length of the shell 0·3, height 0·27, breadth 0·21.

*Habitat.*—Tropical Atlantic, Station 342, depth 1445 fathoms.

### 2. *Conchonia triodon*, n. sp. (Pl. 124, figs. 13, 14).

Shell laterally compressed, with two very unequal valves. Dorsal valve (fig. 14) larger, hat-shaped, on the apex with a large pyramidal horn which is half as long as the shell, curved and directed backwards. Ventral valve (fig. 13) smaller, boat-shaped, without apical horn. Aboral hinge with two pyramidal caudal horns of different sizes, the dorsal horn twice as long as the ventral. Lateral margin of each valve on one side with twelve to fifteen conical teeth. Perhaps the larger horned valve (fig. 14) may be the ventral, and the opposite smaller hornless (seen from above in fig. 13) the dorsal valve.

*Dimensions.*—Length of the shell 0·21, height 0·17, breadth 0·12.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 3. *Conchonia tetrodon*, n. sp.

*Conchura tetrodon*, Haeckel, 1882, Manuscript.

Shell subspherical, with two nearly equal hemispherical valves, which are very thin-walled and similar in structure to those of the Cœlodendrida, with very irregular roundish pores of different shapes and sizes (compare Pl. 121, fig. 3). Lateral margins of the valves with very numerous and irregular, thin, bristle-shaped teeth, similar to those of some Cœlographida (compare Pl. 127, fig. 8). Aboral hinge with two equal, conical, caudal horns, which are straight, parallel, and half as long as the shell. Two similar straight conical horns are opposed on the poles of the sagittal axis, and arise from the apex of the two valves. This remarkable species may perhaps better represent a separate genus, *Conchura*, forming a direct transition to the ancestral form of the Cœlodendrida, *Cœlodoras*; it differs from the latter in the absence of a galea or hollow conical cupola on the apex of each valve, and in the solid, not hollow structure of the horns.

*Dimensions.*—Diameter of the shell 0·24, length of the two sagittal horns 0·1, of the two caudal horns 0·12.

*Habitat.*—Indian Ocean, Cocos Islands (Rabbe), surface.

## Genus 725. *Conchopsis*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Concharida with dentate lateral margins and a sharp sagittal keel of the compressed valves, without horns on the hinge.

[1] *Conchopsis* = Similar to a bivalved shell-fish or mussel; κόγχη, ὄψις.

The genus *Conchopsis* and the following *Conchoceras* differ from the other Concharida in the strong lateral compression of the shell, so that each valve is provided in the sagittal plane with a sharp prominent keel, comparable to the dorsal and the anal fin of fishes. These compressed shells are in general twice to three times as large as the more roundish and keelless shells of the five preceding genera. The sculpture of the fenestrated valves is extremely elegant. *Conchopsis* possesses at the aboral hinge not the two prominent caudal horns, which mark the following genus *Conchoceras*, but in some species a peculiar ligament connects the aboral ends of both valves.

1. *Conchopsis orbicularis*, n. sp. (Pl. 125, fig. 3).

Shell subcircular, lenticular, strongly compressed on both sides, nearly as high as long, its sagittal perimeter nearly circular; frontal and cinctural perimeter spindle-shaped. Borders of the two boat-shaped valves smooth in 0·4 of the oral part, and in 0·1 of the aboral part of their length, strongly dentated in the remaining 0·5 middle part; about twenty-five slender, straight teeth on each side of one valve, size of the teeth increasing from the aboral towards the oral pole. In the half lateral perimeter of the shell (along the right and the left borders of each valve) sixty to sixty-five pores, in the half sagittal perimeter (along the keel of each valve) eighty to eighty-five pores, in the half equator sixty to sixty-five pores.

*Dimensions.*—Length of the shell 0·53, height 0·55, breadth about 0·2.

*Habitat.*—South Atlantic, west of Tristan da Cunha, Station 333, depth 2025 fathoms.

2. *Conchopsis compressa*, n. sp. (Pl. 125, figs. 7, 8).

Shell lenticular, strongly compressed on both sides; proportion of its longitudinal diameter to the sagittal and lateral = 10 : 9 : 3, its sagittal perimeter elliptical (fig. 7), cinctural and frontal perimeter spindle-shaped (fig. 8). Borders of the two boat-shaped valves smooth in 0·3 of the oral, and 0·3 in the aboral part, dentated in the remaining 0·4 middle part; about forty to forty-four very slender teeth of equal size on one lateral edge of each valve. In the half frontal perimeter of the shell (along the border of the valve) sixty-four to sixty-eight pores, in the half sagittal perimeter (along one valve-keel) seventy to eighty pores, in the half equator forty-four to forty-eight pores. Ventral and dorsal pores linear, three to four times as long as the circular, lateral pores.

*Dimensions.*—Length of the shell 0·6 to 0·8, height 0·55 to 0·72, breadth 0·2 to 0·3.

*Habitat.*—North Pacific, between 30° and 40° north latitude (between Japan and San Francisco), in depths from 2000 to 3000 fathoms frequent, Stations 241 to 252.

3. *Conchopsis carinata*, n. sp. (Pl. 123, fig. 8).

Shell subcircular, lenticular, in the central half slightly compressed, nearly spherical, in the peripheral half strongly compressed, with a broad, hyaline, smooth keel on the sagittal plane. Borders of the two valves smooth in the 0·2 of the oral, and 0·1 of the aboral part, strongly

dentated in the remaining 0·7 middle part; about fifty slender teeth of equal size on one lateral edge of each valve. In the half lateral perimeter of the shell about forty-five to fifty pores, in the half sagittal perimeter sixty-five to seventy, in the half equator thirty-two to forty pores. The pores are arranged in parallel curved rows, which are separated by high denticulate crests. Aboral hinge with a strong ligament.

*Dimensions.*—Length of the shell 0·6 to 0·7, height 0·55 to 0·65, breadth 0·35 to 0·45.

*Habitat.*—South Atlantic (east of Patagonia), Station 318, depth 2040 fathoms.

4. *Conchopsis lenticula*, n. sp. (Pl. 123, fig. 9).

Shell subcircular, lenticular, strongly compressed on both sides, with a sharp and broad hyaline keel in the sagittal perimeter. Borders of the two valves smooth in 0·3 of the oral, and 0·2 of the aboral part, strongly dentated in the remaining 0·5 middle part; about thirty strong, conical teeth on the lateral edge of each valve. In the half lateral perimeter of the shell fifty to fifty-five pores, in the half sagittal seventy to seventy-five, in the half frontal forty to forty-five pores. The large central capsule of this species fills up the posterior half of the shell-cavity, the dark green phæodium the anterior half; the latter contains numerous peculiar, longish, nucleated cells (fig. 9*a*), parasites or symbiontes (?). Aboral hinge of the shell with a strong ligament.

*Dimensions.*—Length of the shell 0·7, height 0·6, breadth 0·3.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

5. *Conchopsis pilidium*, n. sp. (Pl. 125, fig. 9).

Shell ovate, lenticular, compressed on both sides, with a broad, wing-like sagittal keel. Proportion of its longitudinal diameter to the sagittal and lateral = 6 : 5 : 3. Sagittal perimeter elliptical. Borders of the two hat-like valves smooth in 0·15 of the oral, and 0·2 of the aboral part, strongly dentated in the remaining 0·65 middle part; about twenty-five to thirty teeth of nearly equal size on one side of each valve. In the half lateral perimeter of the shell (along one border of each valve) forty-five to fifty pores, in the half sagittal perimeter (on the keel of one valve) seventy to seventy-five pores, in the half equator thirty-six to forty pores. Each pore is surrounded by a hexagonal frame. The opening of each valve in this species is bordered and partly closed by a broad, horizontal diaphragm or velum, like the deck of a boat; it is broadest on the oral side.

*Dimensions.*—Length of the shell 0·78 to 0·8, height 0·66 to 0·7, breadth 0·3 to 0·4.

*Habitat.*—South Atlantic, between Buenos Ayres and Tristan da Cunha, Stations 324 to 334, at depths between 1715 and 2900 fathoms.

6. *Conchopsis aspidium*, n. sp. (Pl. 125, figs. 1, 2).

Shell scutiform, strongly compressed on both sides, in the centre only lenticular, in the periphery wing-like, keeled. Proportion of the longitudinal diameter to the sagittal and frontal = 6 : 5 : 2. Sagittal circumference in the oral half semicircular, in the aboral half pentagonal, two

acute corners jutting out near the aboral hinge, one corner in the keel of the dorsal, the outer in the keel of the ventral valve. Borders of the two boat-shaped valves smooth in 0·3 of the oral part, and in 0·1 of the aboral part, strongly dentated in the remaining 0·6 middle part; about thirty-five teeth in one side of each valve, larger on both ends than in the middle. In the half frontal perimeter of the shell sixty to sixty-five pores, in the half sagittal perimeter eighty to eighty-five, in the half equator of the shell forty to fifty pores.

*Dimensions.*—Length of the shell 0·55 to 0·65, height 0·5 to 0·55, breadth 0·2 to 0·22.

*Habitat.*—North Pacific, Stations 243 and 244, depth 2800 to 2900 fathoms.

7. *Conchopsis navicula*, n. sp. (Pl. 125, figs. 4–6).

Shell pear-shaped, compressed on both sides, in the sagittal periphery keeled. Proportion of the longitudinal diameter to the sagittal and lateral = 4 : 3 : 2. Its sagittal perimeter nearly ovate. Borders of the two boat-shaped valves smooth in 0·3 of the oral, and 0·15 of the aboral part, strongly dentated in the remaining 0·55 middle part; teeth conical, of nearly equal size. In the half frontal perimeter of the shell (along one border of each valve) forty to forty-five pores, in the half sagittal fifty-four to fifty-six pores, in the half equator thirty-two to thirty-six pores. Each pore is surrounded by a hexagonal frame, and pierces the shell in an oblique direction, dilated in the middle part (figs. 5, 6). Shell very thick-walled, several longitudinal crests on both sides of the keel of each valve. Hinge very strong, usually with a broad ligament between the two unequal aboral lips of the hinge.

*Dimensions.*—Length of the shell 0·8, height 0·6, breadth 0·4.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

## Genus 726. *Conchoceras*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Concharida with dentate lateral margins and a sharp sagittal keel of the compressed valves, and with two caudal horns on the hinge (a dorsal and a ventral).

The genus *Conchoceras* has the same lenticular keeled and laterally compressed shell as the preceding ancestral genus *Conchopsis*, but is distinguished from it by the development of two large caudal horns on the aboral hinge. It bears therefore the same relation to the latter as *Conchidium* does to *Conchellium*.

1. *Conchoceras caudatum*, n. sp. (Pl. 124, fig. 15).

Shell lenticular, slightly compressed; proportion of the longitudinal diameter to the sagittal and lateral = 6 : 5 : 4; sagittal and cinctural perimeter ovate, frontal perimeter elliptical. Free

[1] *Conchoceras* = Mussel with horns; κόγχη, κέρας.

margins of the two boat-shaped valves dentate nearly in the whole perimeter; in one lateral border of each valve eleven or twelve very large conical teeth, the largest of which are nearly half as high as the valve. On the aboral hinge of the shell two divergent, very large horns, four-sided pyramidal, acute, straight, at the base perforated by a few large pores. The dorsal horn (of the smaller valve) is somewhat shorter than the ventral horn (of the larger valve). The apical distance of both horns is somewhat greater than their length, and about half the length of the shell. In the half frontal perimeter (along one border of each valve) thirty-two to thirty-four pores, in the half sagittal perimeter thirty-four to thirty-eight, in the half equator thirty to thirty-three. The pores are smaller near the girdle-fissure, irregularly quadrangular, and arranged in longitudinal rows, which are separated by meridional crests, and converge towards both poles of the main axis.

*Dimensions.*—Length of the shell (without the horns) 0·24 to 0·26, height 0·20 to 0·22, breadth 0·16 to 0·18; length of the horns 0·1 to 0·13.

*Habitat.*—Eastern part of the Tropical Atlantic, near the Equator, Station 348, depth 2450 fathoms.

2. *Conchoceras cornutum*, n. sp. (Pl. 124, fig. 16).

Shell lenticular, strongly compressed on both sides; proportion of the longitudinal axis to the sagittal and lateral = 4 : 3 : 2. Sagittal perimeter ovate, frontal perimeter elliptical, cinctural perimeter spindle-shaped. Free margins of the two keeled valves in the oral third smooth, in the remaining part strongly dentate; ten or eleven large teeth on one lateral border of each valve, the largest about half as high as the valve. On the aboral hinge of the shell two fenestrated apophyses which bear two stout, strongly curved horns, like pincers; the dorsal horn (of the smaller upper valve) is shorter and less curved than the ventral horn (of the larger lower valve). The lips of the mouth (at left on fig. 16) are also unequal, the upper lip emarginate. In the half frontal perimeter of the valve twenty-two to twenty-four pores, in the half sagittal perimeter twenty-eight to thirty, in the half equator twenty to twenty-two. The pores are separated by high parallel crests and arranged in longitudinal rows, which converge towards the aboral hinge.

*Dimensions.*—Length of the shell (without the horns) 0·36 to 0·4, height 0·27 to 0·3, breadth 0·2 to 0·22; length of the horns 0·16 to 0·22.

*Habitat.*—Tropical Atlantic, Station 338, depth 1990 fathoms.

## Family LXXXIV. Cœlodendrida, Haeckel (Pl. 121).

*Coelodendrida*, Haeckel, 1862, Monogr. d. Radiol., p. 360.

*Definition.*—Phæodaria with a bivalved lattice-shell, composed of two hemispherical valves, a dorsal and a ventral. A conical cupola or a pyramidal galea arises from the apical pole of both valves, therefore at the opposite poles of the sagittal axis. Rhinocanna and frenula wanting. Three or more hollow radial tubes arise from each valve and are symmetrically disposed. Sometimes their branches form an outer

bivalved mantle. The central capsule is so enclosed between the two inner valves, that its three openings lie in the open frontal fissure between them.

The family Cœlodendrida differs from the preceding Concharida (its probable ancestral group) in the development of a conical galea or pyramidal cupola on the apical pole of each valve, and of three or more hollow radial tubes arising from each galea. They do not possess, however, the peculiar sagittal nasal tube or rhinocanna, which is constantly developed from the base of each cupola (and connected with its apex by a frenulum) in the following family, the Cœlographida. These latter differ also from the former in the constant possession of prominent verticillate styles.

The family Cœlodendrida was founded in 1862 in my Monograph (p. 360) and represented hitherto only by two species of the genus *Cœlodendrum*, there described (p. 361, Taf. xiii. figs. 1–3, and Taf. xxxii. fig. 1). This first description, however, contained some errors, which were afterwards (in 1879) corrected by Richard Hertwig; this author also gave the first accurate description of the central capsule and its three openings. In the rich collection of the Challenger, the Cœlodendrida are represented by four genera, but only seventeen species, some of which, however, are cosmopolitan and very common, particularly *Cœlodendrum*.

The two valves of the lattice-shell, dorsal and ventral, are either hemispherical, or somewhat more flatly vaulted or cap-shaped. They are never connected in the equatorial zone of the body, as I supposed in my Monograph (1862, *loc. cit.*); but they are separated by the girdle-fissure, a free circular equatorial interval, in which lie the three openings of the enclosed central capsule. Though the two valves, therefore, have no direct connection, they are, however, always opposed so accurately, that their equal free circular edges correspond exactly one to the other, so that the apex of each valve lies in one pole of the sagittal axis. From this apex there arises on each valve an irregular conical or three-sided pyramidal cupola, the galea (Pl. 121, figs. 3, 4, 8). The Cœlodendrida differ in the possession of this galea from the Concharida, and agree with the Cœlographida; but they never exhibit the peculiar rhinocanna or nasal tube, which arises from each galea in the latter family.

The siliceous lattice-plate of the two valves, and of the galea arising from them, is very thin and fragile, and its irregular roundish pores are extremely variable in size, number, and disposition. Sometimes the pores are so small and so scarce, that the plate appears nearly solid. At other times the siliceous plate seems to be really solid, and covered by a network of thin crests, the small dimples between which give to it the appearance of being fenestrated. Often the pores or the dimples are wanting in the central part of each valve, while they are very numerous and dense in the peripheral part. The same may be said of the lattice-plate of the galea, which is sometimes nearly solid, at other times richly fenestrated. The Cœlodendrida agree in this structure with the following

family, the Cœlographida, and differ from the preceding family, the Concharida, in which the siliceous wall of the two valves is much thicker, and perforated by regular circular or roundish pores.

The galea or conical cupola in the apex of the two valves ("der kegelförmige Aufsatz" of the German authors) has in all Cœlodendrida a triangular base and an irregularly conical or nearly three-sided pyramidal form. Its cavity is about one-third or one-fourth as large in diameter as the cavity of the hemispherical valve upon which it rests. The galea is relatively smaller and more irregularly formed than in the Cœlographida, and differs essentially from that of the latter in the constant absence of a rhinocanna; there are also wanting, therefore, the characteristic frenula, which connect the nasal tube with the apex of the galea. The cavity of the galea probably always communicates with that of the valves by pores in the separating siliceous plate, and is besides pierced by irregular pores in its outer wall, very variable in form, size, and number, but it does not communicate with the cavity of the hollow radial tubes, from which it is separated by a thin, solid, siliceous plate.

The hollow radial tubes which arise from the galea in the Cœlodendrida do not seem to possess that constant regularity in number, origin, and disposition, which is found in the following family, and there serves for distinction of genera. In my first description of the Cœlodendrida (1862, *loc. cit.*, p. 362), I pointed out this irregularity, and mentioned that the number of radial tubes arising from each galea varies from three to eight; the total number therefore amounts to from six to sixteen, the same minimum and maximum numbers which we shall encounter also in the radial styles of the following family. But whilst it is easy to determine the position and relation of these hollow tubes in the Cœlographida, owing to the constant sagittal position of their rhinocanna, this task is very difficult in the Cœlodendrida, where the rhinocanna is wanting. In the most frequent cases there arise from each galea three or four tubes, more rarely five or six, and very rarely seven or eight. The simplest and probably the original case is the development of three tubes, two of which are paired (divergent on the right and left), while the third is odd, lying in the sagittal plane. Perhaps these three primary tubes may be compared to the three cortinar feet of the NASSELLARIA, so that we may regard the two paired anterior as pectoral, and the odd posterior as a caudal tube. Usually the two paired or pectoral tubes arise from two corners of the triangular base of the galea, whilst the third odd or caudal tube does not arise from the third corner of the base, but more or less above it, and often even from the highest point or the apex of the galea. In the majority of species observed, this odd sagittal tube is forked even at its origin, so that two divergent tubes (an anterior and a posterior) arise from the apex of the galea (Pl. 121, figs. 3, 8). More rarely the two paired or pectoral tubes are also forked at the base, so that three pairs of tubes arise from each galea, and the total number of tubes amounts to twelve. Very rarely

four separate tubes or four pairs of tubes arise from each galea, viz., two from the two anterior corners of the basal triangle, one from the posterior corner, and one from the apex of the galea. It is possible that this difference in the origin, furcation, and number of the hollow radial tubes may be employed for the distinction of genera of Cœlodendrida, in the same manner as it is employed in the next following family, the Cœlographida. But I have not been able, in spite of numerous and accurate examinations, to demonstrate in the former the same regularity in number and arrangement of the tubes as in the latter. It seems that these relations here are very variable, even in one and the same species, and not yet fixed.

It is, however, probable, on the other hand, that the primary tubes (all or partly) are identical in the Cœlodendrida and Cœlographida. This is most probably the case with the posterior odd or caudal tube, which seems to be never wanting, and in both families is developed in the form of a dichotomous brush (never in the form of a verticillate style). Possibly also the two paired pectoral tubes are homologous in both families.

The hollow tubes are perfectly simple and unbranched only in one genus, *Cœlodoras*, which is probably the common ancestral form of both families, and which may have been derived from *Concharium* by development of a galea and tubes on the sagittal apex of the valves. All the other Cœlodendrida have branched spines, and the ramification is constantly dichotomous, or repeatedly forked. There never occur in this family those characteristic "styles," or verticillate prolonged tubes, which we find in all Cœlographida. Usually the cylindrical tubes are slightly curved and forked even near their base. The furcation is repeated a variable number of times in the different species. In the largest species each tube becomes a brush with more than one hundred terminal bristles.

We divide the Cœlodendrida into two subfamilies, according to the different development of the distal branches of the hollow tubes. In the Cœlodorida all the branches of the tubes remain free and are never connected by anastomoses, so that the surface of the bivalved skeleton is protected by the free radial distal branches of the tubes. In the larger species of *Cœlodendrum* (*e.g., Cœlodendrum furcatissimum*, Pl. 121, fig. 1), the numerous branches of the dichotomous tubes form a dense thicket, similar to that in the Cœlotholida.

In the second subfamily, Cœlodrymida, the distal branches of the tubes are connected by numerous anastomoses, and compose either a simple lattice-plate on the surface of the skeleton (*Cœlodrymus*), or a thicker envelope of spongy framework (*Cœlodasea*). The lattice-mantle so produced is always bivalved, and its two outer hemispherical valves (dorsal and ventral) correspond exactly to the two inner valves, from which arise the hollow tubes. The free margins of the two external mantle-valves come externally into contact in the equatorial plane of the body, in which the girdle-fissure lies internally between the two central shell-valves. The free edges

of the two external mantle-valves, opposed to one another in the circle of the equator, seem usually to catch one into another in the same way as the corresponding mantle-valves of the Cœloplegmida are loosely connected (Pl. 128, figs. 1, 7). A true concrescence between the two valves seems never to take place.

The two subfamilies of Cœlodendrida therefore exactly correspond to the two subfamilies of the following family, the Cœlographida. The Cœlodorida and Cœlotholida form in a similar way a thicket, by dichotomous ramification of the hollow tubes, all the branches of which remain free. The Cœlodrymida and Cœloplegmida, on the other hand, form an outer lattice-mantle by anastomosing branches. The latter two subfamilies, of course, have been derived correspondingly from the two former, and the common ancestral form of all four is probably *Cælodoras*, derived from the Concharida.

Though the two corresponding subfamilies in both groups are very similar, they are, however, separated by important hereditary characters. All Cœlodendrida (the Cœlodorida without a mantle as well as the Cœlodrymida with a mantle) possess no rhinocanna and no frenula on the galea, and they never develop prominent verticillate styles; the surface of their calymma is probably always spherical or subspherical. All Cœlographida, however (the Cœlotholida without a mantle as well as the Cœloplegmida with a mantle), possess a rhinocanna and frenula on the galea, and always develop prominent verticillate styles; the surface of their calymma is probably always symmetrically polyhedral.

The superficial armature of the skeleton in the Cœlodendrida is rather simple, and by no means so manifold and differentiated as in the more highly developed Cœlographida. The thin terminal branches of the hollow tubes are in the Cœlodorida closed at the distal end, and armed with a variable number of short teeth (Pl. 121, fig. 2), or with a spinulate terminal knob, or a corona of recurved hooks (*ibid.*, figs. 5–7). In the Cœlodrymida, however, where the distal ends of the branches by anastomosing form the lattice-mantle, the spherical surface of this latter is armed with numerous thin spathillæ or radial bristles (often zig-zag or spinulate), and each bristle usually bears at the distal end a small anchor with two, three, or four recurved teeth; the outer convex edge of these teeth is usually smooth, the inner concave edge denticulate. All these ramules and branches of the tubes (also the thinnest terminal threads) are hollow, and filled up by jelly.

The *central capsule* of the Cœlodendrida does not lie outside the two central valves (as I supposed in my first description, in 1862, being deceived by the dark enveloping phæodium, Monogr. d. Radiol., Taf. xxxii. fig. 1), but it is enclosed between the two valves, as in the preceding and the following family. The first accurate description of it was given by Richard Hertwig in 1879 (*loc. cit.*, p. 95, Taf. x. fig. 3). Its constant position between the two lattice-valves (dorsal and ventral) is such, that its three openings lie in the frontal plane, in the open fissure between the valves. The astropyle or the main-opening, with the radiate operculum and the tubular proboscis arising from it, lies on the anterior (or oral)

pole of the main axis, whilst the two lateral accessory openings, or parapylæ, lie on both sides of the posterior (or aboral) pole, to the right and left. The position of the capsule is therefore the same as in the preceding Concharida (Pls. 123–125), and the following Cœlographida (Pls. 126–128). The large nucleus, enclosed in the central capsule, is usually half as broad, and contains numerous nucleoli.

The calymma, or the extracapsular jelly-veil, is in the Cœlodendrida usually spherical, very voluminous, and includes the entire skeleton, the thicket of the Cœlodorida as well as the lattice-mantle of the Cœlodrymida. Only the outermost terminal branches of the tubes in the former, and the radial bristles and spathillæ on the surface of the latter, remain free and project beyond the surface of the calymma. The phæodium is usually very large, three to four times as broad as the central capsule, and envelops it often completely. Usually it envelops only the anterior half of it, and the proboscis (Pl. 121, figs. 1, 9). Often numerous green, brown, or blackish phæodellæ are scattered through the whole calymma, and sometimes accumulate in a superficial layer on its surface. The galea of both valves is usually also filled up by the phæodium.

*Synopsis of the Genera of Cœlodendrida.*

| | | |
|---|---|---|
| I. Subfamily Cœlodorida. Hollow tubes, arising from the galea of both valves, simple or dichotomously branched; the branches always free, not anastomosing. No outer lattice-mantle. | Tubes simple, not branched, | 727. *Cœlodoras.* |
| | Tubes forked or dichotomously branched, | 728. *Cœlodendrum.* |
| II. Subfamily Cœlodrymida. Hollow tubes, arising from the galea of both valves, dichotomously branched; the branches anastomose and form an outer bivalved lattice-mantle. | Lattice-mantle simple; its meshes lying in a spherical surface, | 729. *Cœlodrymus.* |
| | Lattice-mantle spongy; its meshes lying in different planes, | 730. *Cœlodasea.* |

## Subfamily 1. Cœlodorida, Haeckel.

*Definition.*—Cœlodendrida without an external bivalved lattice-mantle, with simple or branched hollow tubes, the terminal branches of which are free, not anastomosing.

### Genus 727. *Cœlodoras*,[1] n. gen.

*Definition.*—Cœlodendrida without external lattice-mantle, with simple, not branched, radial tubes, which arise separately from the galea.

[1] *Cœlodòras*=Hollow spear; κοῖλος, δόρας.

The genus *Cælodoras* is the simplest form of the Cœlodendrida, and may be regarded as the common ancestral form of this and of the following family. It differs from all other members of these two families in the simple shape of the hollow radial tubes which arise from the galea, and are neither branched nor forked; the galea is very small, a flat triangular cap. *Cælodoras* may be derived immediately from *Concharium* or *Conchonia* (p. 1723), by development of the galea and the radial tubes.

1. *Cælodoras hexagraphis*, n. sp.

Three straight, cylindrical, equidistant hollow tubes arise divergent from the three corners of each galea, and are about as long as the diameter of the valves, at the distal end armed with a spinulate knob. The odd sagittal (or caudal tube) is directed backwards, the two paired (or pectoral) tubes, forwards.

*Dimensions.*—Diameter of the valves 0·16, length of the tubes 0·2.

*Habitat.*—Central Pacific, Station 266, depth 2750 fathoms.

2. *Cælodoras octographis*, n. sp.

Four hollow cylindrical tubes, slightly curved, arise divergent from each galea, and are about one and a half times as long as the diameter of the valves, at the distal end knob-shaped, and armed with four crossed, recurved teeth. Two anterior (or pectoral) tubes arise from the two frontal corners of the galea basis, and diverge forwards to right and left. Two posterior tubes (a sagittal and a caudal) arise from the posterior corner of each galea, and diverge in the sagittal plane backwards.

*Dimensions.*—Diameter of the valves 0·2, length of the tubes 0·3.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

Genus 728. *Cælodendrum*,[1] Haeckel, 1860, Monatsber. d. k. preuss. Akad. d. Wiss. Berlin, p. 801.

*Definition.*—Cœlodendrida without external lattice-mantle, with branched radial tubes, the hollow branches of which are free and never connected by anastomoses.

The genus *Cælodendrum* is the first described form not only of the family Cœlodendrida, but of all Phæoconchia or bivalved PHÆODARIA; it is also the most common form of this group, and represented by ten different species, some of which are cosmopolitan, very common, and widely distributed. In my first description of *Cælodendrum* I confounded it erroneously with some forms of *Cælodasea* and *Cælographis*, the separated fragments of which I had found entangled between the branches of the former. The first figures of *Cælodendrum* are given in my Monograph, in 1862,

[1] *Cælodendrum* = Hollow tree; κοῖλος, δένδρον.

Taf. xiii. figs. 1–3 (not 4) and Taf. xxxii. fig. 1 (not 2 and 3). *Cælodendrum* has been derived from *Cælodoras* by furcation and repeated dichotomous ramification of the hollow radial tubes which arise from the galea.

## Subgenus 1. *Cælodendridium*, Haeckel.

*Definition.*—Ramification of the hollow tubes regularly dichotomous, each branch being forked again; therefore the two terminal ramules of the last branches equal.

### 1. *Cælodendrum ramosissimum*, Haeckel.

*Cælodendrum ramosissimum*, Haeckel, 1862, Monogr. d. Radiol., p. 363, Taf. xiii. figs. 1–3.
*Cælodendrum ramosissimum*, R. Hertwig, 1879, Organism. d. Radiol., p. 93, Taf. x. figs. 3, 12.

Terminal branches regularly forked, with two equal, smooth, nearly straight or slightly curved fork-branches, diverging at right angles; their end-knobs with four crossed (or sometimes five or six) short recurved teeth.

*Dimensions.*—Diameter of the spherical skeleton 1·2 to 1·8 of the two central valves 0·2 to 0·25.

*Habitat.*—Cosmopolitan; Mediterranean, Atlantic, Indian, Pacific; many Stations, surface and at various depths.

### 2. *Cælodendrum spinosissimum*, n. sp. (Pl. 121, fig. 7).

Terminal branches regularly forked, with two equal, smooth, straight, fork-branches, diverging at right angles, their end-knobs echinoidal, subspherical or club-shaped, with numerous short radial thorns.

*Dimensions.*—Diameter of the skeleton 2 to 2·2 of the two central valves 0·25 to 0·03.

*Habitat.*—Tropical Atlantic, Stations 346 to 349, surface.

### 3. *Cælodendrum furcatissimum*, n. sp. (Pl. 121, fig. 1–4).

Terminal branches regularly forked, with two equal, smooth, straight, or slightly curved fork-branches, diverging at acute angles; their end-knobs very small, with three short, diverging, conical teeth.

*Dimensions.*—Diameter of the skeleton 2 to 2·5, of the two central valves 0·3 to 0·4.

*Habitat.*—Cosmopolitan; Atlantic, Indian, Pacific; many Stations, surface, and at various depths.

### 4. *Cælodendrum bifurcum*, n. sp.

Terminal branches regularly forked, with two equal, smooth, more or less curved fork-branches, diverging at acute angles; their end-knobs thin, with two slender, parallel, bristle-shaped teeth.

*Dimensions.*—Diameter of the skeleton 0·6 to 0·8, of the two central valves 0·1 to 0·15.

*Habitat.*—North Pacific, Stations 252 to 256, surface.

### 5. *Cœlodendrum gracillimum*, Haeckel.

*Cœlodendrum gracillimum*, Haeckel, 1862, Monogr. d. Radiol., p. 364, pl. xxxii. fig. 1.

Terminal branches regularly forked, with two equal, spinulate, curved fork-branches, diverging at obtuse angles and covered with numerous small thorns; their end-knobs cap-shaped, with a corona of six to eight small recurved teeth. In one specimen of this species (in 1859) I found entangled the fragments of *Cœlographis gracillima*, figured in Taf. xxxii. figs. 2, 3, *loc. cit.* I supposed at that time, erroneously, that the latter belonged to full-grown specimens of the former.

*Dimensions.*—Diameter of the skeleton 1 to 1·2, of the valves 0·15 to 0·2.

*Habitat.*—Mediterranean (Messina), surface.

### 6. *Cœlodendrum lappaceum*, n. sp.

Terminal branches regularly forked, with two equal, spinulate, straight or slightly curved fork-branches, diverging at acute angles and covered with small recurved hooks; their end-knobs large, conical, with a prominent apex and a basal corona of six to eight recurved teeth.

*Dimensions.*—Diameter of the skeleton 1·5 to 1·8, of the valves 0·22.

*Habitat.*—South Pacific, Stations 285 to 295, depth 1500 to 2600 fathoms.

## Subgenus 2. *Cœlodendronium*, Haeckel.

*Definition.*—Ramification of the hollow tubes more or less irregular, mainly in the periphery; the terminal ramules of the last branches unequal.

### 7. *Cœlodendrum cervicorne*, n. sp. (Pl. 121, fig. 8).

Terminal branches irregularly ramified, with unequal, smooth, curved ramules, diverging at obtuse angles, their end-knobs echinoidal, small, with short, diverging, conical thorns.

*Dimensions.*—Diameter of the skeleton 1 to 1·2, of the valves 0·2.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

### 8. *Cœlodendrum digitatum*, n. sp.

Terminal branches irregularly ramified, with unequal, spinulate, straight ramules, diverging at acute angles; the two last fork-branches digitate, each with five diverging finger-shaped ramules, lying in a meridian plane; their end-knobs conical, pointed, with a corona of recurved hooks.

*Dimensions.*—Diameter of the skeleton 1·6, of the valves 0·24.

*Habitat.*—Indian Ocean, Madagascar (Rabbe) surface.

9. *Cœlodendrum flabellatum*, n. sp. (Pl. 121, fig. 6).

Terminal branches flabellate, irregularly ramified, each of the last two fork-branches being divided into four or five diverging straight branches of different lengths; usually the last eight or ten ramules lie in a meridional plane; their end-knobs cap-shaped, with a corona of recurved teeth.

*Dimensions.*—Diameter of the skeleton 2·0 to 2·5, of the valves 0·25 to 0·3.

*Habitat.*—North Pacific, Station 235 to 240, surface.

10. *Cœlodendrum serratum*, n. sp. (Pl. 121, fig. 5).

Terminal branches flabellate, irregularly ramified like the preceding species; it differs from this in the strong compression of the broad, saw-shaped, terminal branches; the two opposite edges (placed in the meridional plane of the flabellum) are finely serrated; their end-knobs with a corona of diverging teeth.

*Dimensions.*—Diameter of the skeleton 3·0 to 3·2, of the valves 0·3 to 0·36.

*Habitat.*—Central Pacific, Stations 270 to 274, depth 2350 to 2925 fathoms.

## Subfamily 2. Cœlodrymida, Haeckel.

*Definition.*—Cœlodendrida with an external bivalved lattice-mantle, produced by the anastomosing branches of the hollow radial tubes.

### Genus 729. *Cœlodrymus*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Cœlodendrida with an external bivalved lattice-mantle, produced by the anastomosing terminal branches of the hollow tubes, which are connected in a spherical face.

The genus *Cœlodrymus*, and the following closely allied genus *Cœlodasea*, represent together the small subfamily Cœlodrymida, differing from the Cœlodorida in the possession of an outer bivalved lattice-mantle. They exhibit therefore the same relation to the latter, that in the following family the Cœloplegmida bear to the Cœlotholida. The bivalved spherical mantle is composed of a simple lattice-plate in *Cœlodrymus*, of a spongy framework in *Cœlodasea*; the anastomosing branches of the hollow radial tubes become connected in the former in a spherical face, in the latter in the form of a spongy framework.

[1] *Cœlodrymus*=Forest of hollow trees, κοῖλος δρυμός.

1. *Cœlodrymus ancoratus*, n. sp. (Pl. 121, figs. 9, 10).

Network of the mantle loose, with large, irregular, polygonal meshes; the terminal branches of the forked trees, which communicate at the spherical surface of the calymma, and compose the mantle, are smooth. Spherical surface covered with very numerous and thin zigzag radial filaments, which are about as long as the galea, and bear at the distal end an anchor with two recurved teeth, denticulate at the concave proximal edge (fig. 10).

*Dimensions.*—Diameter of the spherical lattice-mantle 2 to 2·5, of the valves 0·3 to 0·4.

*Habitat.*—South-Eastern Pacific (off Juan Fernandez), Station 300, depth 1375 fathoms.

2. *Cœlodrymus lappulatus*, n. sp.

Network of the mantle rather dense, with numerous and small irregular polygonal meshes; the terminal branches of the forked trees, which compose the mantle, are spinulate. Spherical surface densely studded with very numerous spinulate, radial filaments, which are about half as long as the galea, and bear at the distal end an anchor with four crossed recurved teeth, denticulate at the concave proximal edge.

*Dimensions.*—Diameter of the spherical lattice-mantle 2·5 to 3, of the valves 0·4 to 0·5.

*Habitat.*—South-Western Pacific (east of New Zealand), Station 169, depth 700 fathoms.

3. *Cœlodrymus echinatus*, n. sp.

Network of the mantle very dense, with very numerous and small irregular roundish meshes; the terminal branches of the forked trees, which compose the mantle, are spiny. Spherical surface studded with very numerous, thin, radial bristles, which bear no anchor at the distal end.

*Dimensions.*—Diameter of the spherical lattice-mantle 1·8, of the valves 0·22.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

## Genus 730. *Cœlodasea*,[1] n. gen.

*Definition.*—Cœlodendrida with an external spongy lattice-mantle, produced by the anastomosing branches of the hollow tubes, which are connected in different heights.

The genus *Cœlodasea* differs from the preceding *Cœlodrymus* in the spongy structure of the outer bivalved mantle. The hollow branches of the radial tubes of *Cœlodendrum*, which anastomose in *Cœlodrymus* only on the spherical surface of the calymma, and form a simple lattice-sphere, become connected in *Cœlodasea* in different planes (laterally and terminally), and therefore form an irregular spongy framework. The latter exhibits therefore to the former a relation similar to that which *Spongoplegma* bears to *Carposphæra* among the Sphæroidea.

[1] *Cœlodasea* = Hollow thicket, κοῖλος δάσεα.

1. *Cœlodasea ramosissima*, Haeckel.

*Cœlodendrum ramosissimum* (*partim*), Haeckel, 1862, Monogr. d. Radiol., p. 363, Taf. xiii. fig. 4.

Spongy framework of the spherical bivalved mantle very dense and thick, produced by very numerous, irregular anastomoses of the lateral and terminal branches, which arise from the hollow tubes. The last and thinnest terminal branches are forked, as seen in the radial section of fig. 4 (*loc. cit.*), their ends are closed and armed with some very small denticles (not open, as figured in fig. 4). In my Monograph I had confounded this species with *Cœlodendrum ramosissimum*, which however, may possibly be its ancestral form.

*Dimensions.*—Diameter of the spongy spherical mantle 2 to 2·5, of the central valves 0·15.

*Habitat*—Mediterranean (Messina), surface.

2. *Cœlodasea spongiosa*, n. sp.

Spongy framework of the bivalved mantle rather loose, not nearly so thick and dense as in the preceding species. The last and thinnest terminal branches are prolonged into denticulate, zigzagged, radial filaments, which bear at their distal end an anchor with two recurved teeth (similar to *Cœlodrymus ancoratus*, Pl. **121**, figs. 9, 10).

*Dimensions.*—Diameter of the spongy spherical mantle 3 to 3·2, of the central valves 0·24.

*Habitat.*—Equatorial Atlantic, Station 347, depth 2250 fathoms.

## Family LXXXV. CŒLOGRAPHIDA, n. fam. (Pls. **122, 126–128**).

*Definition.*—PHÆODARIA with a bivalved lattice-shell, composed of two hemispherical valves, a dorsal and a ventral. A conical cupola or a helmet-shaped galea arises on the apical pole of each valve, therefore on the opposite poles of the sagittal axis. The cavity of the galea communicates with the sagittal rhinocanna, a peculiar nasal tube, which rests upon the valve, and is connected with the galea by a simple or double frenulum; its opening being directed towards the proboscis. Three or more branched hollow radial tubes arise from each valve, and are symmetrically disposed. Sometimes their branches form an outer bivalved mantle. The central capsule is so enclosed between the two inner valves, that its three openings lie in the open frontal fissure between them.

The family Cœlographida, the last family of the PHÆODARIA, exhibits the highest degree of morphological development, not only in this group, but among all Radiolaria. They attain also the greatest size of all members of the class, since the diameter of their body is sometimes more than 20 mm., and in a few species even more than 30 mm. The complexity of their structure attains at the same time such a high degree, that they may be regarded as the most complicated, and (in a morphological sense) as the most highly developed of all Protozoa. Nevertheless their body always remains a single cell,

and is closely allied to the preceding Cœlodendrida; they differ from the latter mainly in the development of a peculiar new organ, the "rhinocanna," or "nasal tube." This is a hollow tube placed in the sagittal plane, arising from the base of each galea, and is connected with its apex by a simple or double frenulum. Between the oral openings of the two opposed rhinocannæ (one dorsal and one ventral) lies the proboscis of the central capsule.

The first observed species of Cœlographida was *Cœlographis gracillima*, some parts of which (but not the entire skeleton) were figured in my Monograph (1862, Taf. xxxii. figs. 2, 3). But I confounded these with *Cœlodendrum gracillimum*, in the branched hollow trees of which the fragments of the former were entangled. I detected this error afterwards, when I had the opportunity of observing some complete specimens. The first description of a complete skeleton was given in 1882 by O. Bütschli, who examined a large specimen of *Cœlothamnus davidoffii*, captured by Davidoff in the Mediterranean (Zeitschr. f. wiss. Zool., Bd. xxxvi. p. 486, Taf. xxxi.). In the rich collection of the Challenger I was able to distinguish not less than nine genera and twenty-six species of Cœlographida, but the majority of their large and most fragile skeletons were more or less injured, or quite broken. It was, therefore, of the highest importance for the minute study of this difficult group, that Dr. John Murray, during his expedition to the Færöe Channel (in 1882, in H.M.S. "Triton"), discovered in the Gulf Stream the beautiful *Cœloplegma murrayanum*, and brought up home hundreds of well-preserved specimens (Pl. 127). Only by the complete examination of this excellent material it was possible to answer many difficult questions as to their morphology, and to correct the errors in my description and in that of Bütschli.

We divide the family Cœlographida into two rather different subfamilies, which may afterwards be separated as two divergent families, the Cœlotholida (Pl. 122) and Cœloplegmida (Pls. 126–128). Both groups may be easily distinguished at a glance, since the numerous branches, arising from the hollow radial tubes, remain constantly free and independent in the former, and represent a spiny thicket, whilst in the latter they constantly become united, and by anastomosing form a peculiar "mantle," or outer envelope of delicate network. But besides, there are other and more important differences between the two groups. The peculiar hollow tube, arising from the base of the galea on each valve, which is filled with phæodella, and which we call the rhinocanna, develops in the Cœlotholida on its open mouth two paired lateral frenula (right and left), which connect it (like two lateral bridges) with the base of two paired hollow main tubes (the "frontal tubes"). In the Cœlospathida, however, the mouth of the rhinocanna develops a single odd frenulum only (in the sagittal plane), and is connected by it with the base of an odd, single, hollow main tube, directed forwards, the "nasal style."

The central bivalve lattice-shell, from which the galea and the tubes arise, exhibits in

the Cœlographida essentially the same form and structure as in the preceding Cœlodendrida. The only (but important) difference between them is indicated by the constant presence of the peculiar rhinocanna in the former, whilst this is always absent in the latter. The two valves of the shell, dorsal and ventral, are either hemispherical or somewhat flatter, sometimes nearly cap-shaped, and formed of an extremely delicate and irregularly fenestrated plate of silica, as in the Cœlodendrida. As in the latter, so also in the Cœlographida both valves are of similar form and usually of equal size, but sometimes the dorsal is a little smaller than the ventral valve. The remarkable difference which Bütschli describes in his *Cœlothamnus davidoffii*, and the inverse origin of the three tubes in both valves (*loc. cit.*, Taf. xxxi. figs. 2, 4), depends upon an error of observation, produced by the artificial inversion of one valve, and the dislocation of their natural arrangement. The valves are never in direct contact, but separated by the equatorial fissure or girdle-cleft, in which the girdle zone of the enclosed central capsule and its three openings lie freely (Pl. **127**, figs. 4, 5; Pl. **128**, fig. 2). The free margins of both valves, which are opposite to one another, and bound the girdle-cleft, are always equidistant, so that the cleft in the whole equatorial circumference is of equal breadth. The margins are usually irregularly denticulate, sometimes armed with longer bristles (Pl. **127**, fig. 8), more rarely smooth (fig. 5). The delicate lattice-work of the valves is always irregular and very variable, usually with numerous small and unequal pores, sometimes rudimentary, so that the valves appear partly solid and hyaline. The size of the valves is usually between 0·2 and 0·5 (in diameter).

The galea (*g*) or the apical cupola, which arises from the vaulted apex of each valve (or its sagittal pole) is more developed in the Cœlographida than in the preceding Cœlodendrida, and differs from the latter in the peculiar rhinocanna arising from its base, and in the single or double frenulum, connecting the open mouth of the rhinocanna with the odd or paired main tube arising from the galea. The two opposite galeæ lie therefore on the poles of the sagittal axis of the bivalve shell, and are so symmetrically disposed in the sagittal plane, that the open mouths of their rhinocannæ are directed towards the oral pole of the main axis, and nearly come in contact with the proboscis arising from the radiate operculum of the central capsule (Pl. **127**, figs. 4, 5).

The size and form of the galea are very variable, even in one and the same species. The volume of its cavity is generally about as great as that of the hemispherical valve from which it arises, sometimes larger, at other times smaller. Its fundamental form is constantly dipleuric or bilateral, since the radial hollow tubes arise symmetrically on both its sides, and the rhinocanna proceeding from its base determines the sagittal plane. Usually the galea has the form of a vaulted helmet, the convex crest of which is inclined towards the mouth (Pl. **127**, figs. 4, 5, 8, 9). Its anterior or apical part is broad and truncated in the Cœlotholida, more or less conical in the Cœlospathida; sometimes it assumes nearly the form of a bilateral three-sided pyramid, at other times it is more

pear-shaped (Pls. 126–128). The thin siliceous wall of the galea has the same irregular and delicate network as the valve from which it arises, and sometimes the small irregular pores are also here reduced, so that the wall becomes partly solid. In some cases the thin, solid, siliceous plate of the galea and of the valve is covered by an irregular delicate network of crests; the dimples between these crests may be easily confounded with true pores.

The cavity of the galea is filled with phæodella and does not communicate with the cavity of the shell-valves, nor with the cavity of the radial tubes filled by jelly; it is closed towards the latter and the former by a thin solid plate of silex. Bütschli (1882, *loc. cit.*, p. 488) describes in *Cœlothamnus* a large circular opening (Taf. xxxi. figs. 2*a*, 4*a*), and states that this is a direct communication between the cavities of the valves and of their galeas which are called by him "der dreiseitige kastenförmige Aufsatz" (ε). This error was caused by the fact that he observed the valves from the apical face only. The apparent opening of communication does not exist, and is the optical section of the rhinocanna, the shortened walls of which he describes as "trapezförmige Kiesellamelle" (γ); the two lateral edges of the latter ("die seitlichen Zipfel," δ) are the paired frenula, which connect the open mouth of the rhinocanna with the base of the two frontal tubes.

The "rhinocanna or nasal tube" (Pl. 126, figs. 1, 4; Pl. 127, figs. 4–9*t*) is a very remarkable organ which is common to all Cœlographida (without any exception), and distinguishes them markedly from all the other Radiolaria, and particularly from the closely allied Cœlodendrida, in which we find no trace of it. The rhinocanna is a cylindrical or three-sided prismatic hollow tube, which lies in the sagittal plane, on the outer surface of each valve, arises from the base of the galea, and is directed towards the proboscis of the central capsule. The two opposite rhinocannæ open on each side of the latter (Pl. 127, figs. 4–9*m*), and usually this "nasal mouth" or the anterior opening of the nose is somewhat dilated or even funnel-shaped. The posterior opening of the nose passes directly over into the base of the cavity of the galea.

Usually the rhinocanna is densely filled up by dark phæodella, which enter by this channel into the cavity of the galea (Pl. 127, figs. 4, 5, 9). Sometimes the entire phæodium is enclosed in the two galeæ and their rhinocannæ (figs. 5, 9), whilst at other times a great part of the phæodium lies outside of their cavities, and surrounds the proboscis of the mouth, or even the anterior half of the central capsule (fig. 4). The length of the cylindrical rhinocanna is usually about equal to that of the galea, whilst the diameter of the latter is from three to five times as great as that of the former. The structure of the thin wall is the same in both. The fine reticulation (fig. 8) is produced either by true, very small and irregular pores, or by a fine network placed on the solid thin wall. We may distinguish on each rhinocanna an outer or distal convex face, which is opposite to the proximal concave face of the galea, and an inner concave or proximal face, which rests immediately upon the convex outer face of the shell-valve; a thin solid lamella of

silica here completely separates the cavities of the valve and of the rhinocanna resting upon it.

The "frenula or nasal suspensoria" (Pl. 127, figs. 4–9*b*) are thin ligaments of silica, which connect the nasal mouth (*m*) with the base of the main tubes arising from the galea; they are, therefore, also common to all Cœlographida, and an exclusive and marked attribute of this family. They are, however, different in the two subfamilies of this group, corresponding to the different origin of the odd or paired main tubes. In the Cœloplegmida (Pls. 126-128) from the apex of each galea arises an odd main style, the nasal style (*g* 1), and its base is connected with the nasal mouth by an odd frenulum (*b*). In the Cœlotholida however (Pl. 122) the large nasal odd style is always wanting, and there arise two paired frontal tubes from the two corners of the truncate frontal face of the galea; therefore two paired frenula are developed (a right and a left), and these, converging towards the nasal mouth, connect its distal corner with the base of the two frontal tubes.

The odd frenulum of each valve of the Cœloplegmida lies therefore in the sagittal plane, whilst the two paired frenula of the Cœlotholida lie on both sides of it, to the right and left. The frenula seem to be supporting columellæ or pillars, which support the fragile skeleton, and mainly effect a fixed prop for the fragile galea. In the Cœlotholida the frenula are often rather broad and irregularly fenestrated lamellæ of silica (Pl. 122, fig. 2), whilst in the Cœloplegmida they are usually thin ligaments, fenestrated only at the broadened ends, which are inserted inside on the distal apex of the nasal mouth, and outside on the base of the nasal main styles.

The large hollow tubes which arise from the galea of all Cœlographida, are very variable in number, size and shape, but are always richly branched and symmetrically arranged in the dorsal and the ventral valve of the shell. They exhibit an important difference in the two subfamilies of the group; in the Cœlotholida all the branches, and also the thin terminal ramules, are free, without any junction; in the Cœloplegmida, however, they communicate by frequent anastomoses, and the connected terminal ramules form on the surface of the calymma an outer lattice-mantle of very delicate network. Another marked difference between the two families is indicated by the origin and site of those main tubes which are connected with the rhinocanna by a frenulum. In the Cœloplegmida an odd, very large main tube (the nasal style) arises from the anterior apex of each galea and bears on its base an odd frenulum. This nasal style and its frenulum is altogether wanting in the Cœlotholida, where two paired main tubes (the frontal tubes) arise from the lateral corners of the truncate anterior side of the galea, and are connected with the mouth of the rhinocanna by two paired convergent lateral frenula.

We distinguish in all Cœlographida two different forms of hollow branched tubes, which we will call "brushes" and "styles." The brushes are dichotomously branched from the base, not verticillate; their distal ramules remain separate in the Cœlotholida

and compose the spiny surface of the peculiar "fork-thicket;" whilst in the Cœlographida they become connected by frequent anastomoses and form the outer "lattice-mantle." The styles, however, are much longer, projecting over the surface of the thicket or the mantle, and are not dichotomously branched, but verticillate, or armed with cruciate or alternately cruciate pairs of branches; the larger branches of the styles may be again dichotomously branched, like the brushes; whilst the free prominent parts of the styles are always verticillate or cruciate-pinnate. The brushes are identical with the hollow tubes of the Cœlodendrida, whilst the styles are peculiar forms of apophyses, wanting in the latter.

The minimum number of hollow tubes which arise from each valve is three, and these are probably homologous with the three primary tubes of the Cœlodendrida. Two of these are paired (right and left), whilst the third is odd and lies in the sagittal plane; they have the same position as in the tripodal NASSELLARIA, and may therefore bear the same names, the two paired anterior or pectoral tubes being divergent forwards, the odd or caudal tube being directed backwards (so in the Cœlotholida, Pl. **121**). The odd caudal tube (probably identical with the odd tube of the Cœlodendrida) is always a brush, dichotomously branched, and never prolonged into a free style. The two paired frontal or pectoral tubes, however, are usually prolonged into two long verticillate styles. The basal origin also of these three primary tubes is different. The two pectoral or anterior paired tubes always arise from the galea itself, whilst the posterior odd or caudal tube usually arises behind the galea from the valve (Pl. **127**, figs. 4–8, *g* 6).

Since these three primary tubes, the odd caudal and the paired pectoral, are probably homologous in all Cœlographida and Cœlodendrida, they have a great morphological importance, similar to the three primary feet of the NASSELLARIA. All other tubes arising from the valves must be regarded as secondary apophyses, since they are not constant in all members of the two families, but present only in some of them. All the Cœlotholida observed (a small number of species only) possess no secondary tubes, but only the three primary; whilst all Cœloplegmida possess one or more secondary tubes, and one of these is constant, viz., the odd nasal style, directed towards the mouth, and arising as the foremost from the apex of the galea (Pl. **127**, figs. 4–8, *g* 1).

The maximum number of tubes observed, which arise from each valve in the Coloeplegmida, is eleven; five of these are odd and placed in the sagittal plane of the body, viz.:—(A) the primary caudal tube (Pl. **127**, figs. 4–8, *g* 6); (B) an odd procaudal tube, arising between the caudal and the sagittal tube; (C) the sagittal tube, placed either in the sagittal axis of the body or near it (often prolonged into a sagittal style, Pl. **128**, fig. 1); (D) an odd postnasal tube, arising between the sagittal and the nasal tube; (E) the odd nasal tube, constant in all Cœloplegmida, and connected at its base by the odd frenulum with the rhinocanna (Pl. **127**, figs. 4–8, *g* 1). All other tubes occurring in the Cœloplegmida are paired, and symmetrically arranged on both sides of the sagittal

plane, at right and left; their maximum number is three pairs, viz.:—(F) the paired pectoral tubes (as the foremost), directed forwards; (G) the paired frontal or lateral tubes, placed either in the frontal axis of the valve, or in a neighbouring axis, directed towards the right and left pole (Pl. **127**, figs. 4–8, *g* 4 and *g* 5); (H) the paired tergal tubes, directed backwards (constant in all Cœloplegmida). The origin of these tubes is rather variable, since they arise in nearly allied species, sometimes independently of one another, at other times united at the base. But a closer comparison of them in the different species will demonstrate their homology, caused by constant heredity.

The terminal ramules of the brushes, which form the subspherical "fork-thicket" in the Cœlotholida, the outer "lattice-mantle" in the Cœloplegmida, are constantly armed at the distal ends either with spathillæ or with anchor-pencils, bunches of those most elegant spinulate threads, which bear at the free end an anchor, or a whorl of two, three, or four recurved teeth (Pl. **122**, fig. 8; Pl. **127**, fig. 10; Pl. **128**, figs. 1, 6). The pencils are usually dichotomously branched, their threads zig-zag or delicately serrate, often armed with very small recurved denticles, and the anchor teeth (commonly three or four) are usually smooth on the convex outer, serrate on the concave inner edge. The entire surface of the subspherical thicket in the Cœlotholida, and of the polyhedral lattice-mantle in the Cœloplegmida, is armed with thousands of those most elegant spathillæ, or anchor-pencils.

The "fork-thicket" of the Cœlotholida is identical with that of the Cœlodendrida, and is composed only of the innumerable dichotomous branches of the hollow tubes. It envelops the two central valves and the enclosed central capsule in the same way as in the Cœlodendrida. But the Cœlotholida differ from these latter in constantly possessing a rhinocanna and two frenulæ. The entire form of this thicket, which in the few species observed was never complete, but always more or less destroyed, is usually probably subspherical or polyhedral, sometimes cordate or kidney-shaped. Its surface is densely studded with thousands of spathillæ. Its diameter is about four to eight times as great as that of the enclosed bivalve shell.

The "lattice-mantle" of the Cœloplegmida, which replaces in this subfamily the fork-thicket of the Cœlotholida, is always produced by the anastomoses of the distal ramules of the brushes, and of those branches of the styles which do not proceed over the surface of the mantle. Its network is always very irregular, and composed of polygonal meshes of very different sizes. Usually it is quite simple, and may be compared with the cortical shell of the Disphærida. More rarely it is more or less spongy. Its surface is densely studded with thousands of spathillæ or anchor-pencils. The entire form of the lattice-mantle is always symmetrically polyhedral, since its dorsal and ventral halves are symmetrically developed on both sides of the equatorial plane, and therefore correspond perfectly to the enclosed smaller halves of the central bivalve shell. The two valves of the lattice-mantle (dorsal and ventral valves) are never really united and grown together,

but are in loose contact in the equatorial plane; here the free edges of both valves catch into one another by means of free ramules (Pl. 128, figs. 1, 7). This loose connection is similar to what occurs in the Conchopsida (or in the Concharida with dentate edges), but never so regular. The special form of the polyhedral lattice-mantle depends on the number, arrangement, and development of the styles, which proceed over its surface; it preserves the polyhedral form of the calymma, on the surface of which it is deposed.

The characteristic styles of the Cœlographida (which are never found in the preceding Cœlodendrida) are longer hollow tubes, symmetrically disposed on both valves. They are prominent over the surface of the fork-thicket in the Cœlotholida, of the lattice-mantle in the Cœloplegmida. They bear in these latter a peculiar terminal coronet on their distal end, whilst in the former this end is armed with large pencils of spathillæ. The styles may be forked once or twice at their base, but in their greatest part they are verticillate, and not dichotomously branched like the brushes. The lateral branches of the styles are usually very numerous and regularly cruciate in alternating opposite pairs. In the odd nasal style, *e.g.*, the first and third pairs of opposite lateral branches usually lie in the frontal plane, the second and fourth in the sagittal plane, perpendicular to the former, and so on. A similar regular disposition of the lateral branches is found also in other styles, but not in all. There are certain styles in which the lateral branches are not opposite in pairs, but alternate or verticillate, and others in which they represent unequal branches of forks, so that each single segment of the branched style represents the stouter branch of a fork, and the appertaining lateral branch the thinner branch of the fork. Further accurate examinations are required to recognise the different laws of the ramification of the styles in the different forms of Cœlographida. The lateral branches of the styles are usually again dichotomously branched inside the lattice-mantle, and their distal ends pass over into its network. But the verticillate or cruciate branches, which arise from the free part of the styles outside the lattice-mantle, are always armed with the same elegant pencils of spathillæ which cover the surface of the fork-thicket in the Cœlotholida, the surface of the lattice-mantle in the Cœloplegmida. These pencils also are often regularly opposite in pairs, and the pairs alternate in two planes perpendicular one to another (Pl. 128, figs. 1, 4).

The terminal coronets are peculiar ornaments which protect the distal ends of the styles in the Cœloplegmida, whilst in the Cœlotholida these are armed with the usual pencils of spathillæ (Pl. 122, fig. 8). Each coronet is usually produced by the double, triple, or quadruple furcation of the free distal end of the style; therefore composed of four, eight, or sixteen terminal branches, which, on account of their peculiar form and function, we may call "fingers." More rarely the ramification of the coronets is more or less irregular, and sometimes the number of the fingers exceeds twenty or even thirty.

In the majority of species eight fingers are regularly disposed (Pl. 127, figs. 1–3; Pl. 128, figs. 1–8). Often too sixteen occur, rarely four only. Sometimes the fingers

are placed nearly in one plane and form a hand. The form of the fingers is very variable and most characteristic of the individual species. Very often they have the shape of a human finger, and are smooth, spinulate, or armed with recurved hooks. The distal end of each finger often again bears a small coronet or a spathilla (Pl. **128**, figs. 5–9), and sometimes it is arrow-shaped (Pl. **126**, fig. 2*a*). All these apophyses of the terminal coronets as well as the anchor-pencils of the mantle and the finest branches of the tubes, are hollow and filled up by jelly.

The different number and arrangement of the styles offers the best means for the distinction of genera in the Cœlographida. The minimum number is six (*Cœlographis*, Pl. **126**, fig. 1), the maximum number sixteen (*Cœlothamnus*, Pl. **122**, fig, 3, and *Cœlagalma*, Pl. **126**, fig. 4). Since the arrangement of the styles in both valves is constantly symmetrical, the fundamental form of the whole body is in all Cœloplegmida "amphithect," as in the *Ctenophora*. The longitudinal or main axis of the body is vertical, with two distinct poles; the proboscis of the central capsule and the two rhinocannæ are directed upwards, towards the oral pole; the caudal tube of each valve is directed downwards, towards the aboral pole. The two other axes of the body are unequal, horizontal, and perpendicular one to the other; each has two equal poles. On the poles of the sagittal axis lie the galeæ of the dorsal and ventral valves; on the poles of the frontal axis lie the two secondary openings or parapylae of the central capsule. The frontal fissure or the large cleft between the dorsal and ventral valves of the skeleton lies in the vertical frontal plane of the body, which is perpendicular to the vertical sagittal plane; the equatorial plane, however, is horizontal.

The *central capsule* of the Cœlographida exhibits the same shape and position as in the preceding Cœlodendrida. It is subspherical, slightly depressed in the direction of the main axis, and lies enclosed between the two central valves of the lattice-shell. Its three constant openings lie in the frontal plane, and therefore in the frontal fissure between the two valves. The astropyle, or the main-opening of the capsule, lies on the oral pole of the main axis, and its radiate operculum (*d*) is directed upwards; the curved proboscis arising from it (*o*) is prominent between the mouths of the two opposed rhinocannæ. The two lateral parapylæ or accessory openings lie on both sides of the aboral pole, on the right and left (Pl. **127**, figs. 4–6). The large spheroidal or somewhat lenticular nucleus (*n*) is usually about half as broad as the capsule, and contains numerous nucleoli. The protoplasm around the nucleus contains many vacuoles, and in the oral part of the capsule (between nucleus and operculum) often numerous groups of crystals (Pl. **127**, figs. 4–6*k*, 7). The double membrane of the central capsule exhibits the same shape as in the other PHÆODARIA.

The calymma, or the extracapsular jelly-veil, is in the Cœlographida very voluminous, and includes the entire skeleton, the fork-thicket of the Cœlotholida, the lattice-mantle of the Cœloplegmida, and also the prominent large styles. Only the distal ends of the

latter (with the terminal coronets), and the anchor pencils, covering the surface of the thicket and the mantle, seem to project over the surface of the calymma. The entire form of the latter is therefore a symmetrical polyhedron. The phæodium fills up a small part only of the calymma, and is usually enclosed in the two galeæ and their rhinocannæ (Pl. 127, figs. 5, 9), but often also a part of the phæodium is scattered around the oral half of the central capsule.

*Synopsis of the Genera of Cœlographida.*

| | | | |
|---|---|---|---|
| I. Subfamily Cœlotholida. Rhinocanna of each valve with two paired lateral frenula. The distal ends of the dichotomous brushes are not united by anastomoses, and form an outer bivalved fork-thicket. | Eight paired styles (four on each valve), | | 731. *Cœlotholus.* |
| | Twelve paired styles (six on each valve), | | 732. *Cœlothauma.* |
| | Sixteen paired styles (eight on each valve), | | 733. *Cœlothamnus.* |
| II. Subfamily Cœloplegmida. Rhinocanna of each valve with an odd sagittal frenulum. The distal ends of the dichotomous brushes are united by anastomoses, and form an outer bivalved lattice-mantle. | Mantle with six styles. | One odd and two paired styles on each valve, | 734. *Cœlographis.* |
| | Mantle with eight styles. | Two odd and two paired styles on each valve, | 735. *Cœlospathis.* |
| | Mantle with ten styles. | One odd and four paired styles on each valve, | 736. *Cœlodecas.* |
| | Mantle with twelve styles. | Two odd and four paired styles on each valve, | 737. *Cœlostylus.* |
| | Mantle with fourteen styles. | One odd and six paired styles on each valve, | 738. *Cœloplegma.* |
| | Mantle with sixteen styles. | Two odd and six paired styles on each valve, | 739. *Cœlagalma.* |

## Subfamily 1. CŒLOTHOLIDA, Haeckel.

*Definition.*—Cœlographida with two paired lateral frenula on each galea, and with free terminal branches on the hollow radial tubes, without an external lattice-mantle. Eight to sixteen long styles are prominent over the surface of the fork-thicket, which is composed of the caudal brush and the dichotomous basal branches of the styles.

### Genus 731. *Cœlotholus*,[1] n. gen.

*Definition.*—Cœlographida with two paired lateral frenula on each galea, without external lattice-mantle, armed with eight styles (two pairs of styles on each valve).

[1] *Cœlotholus*=Hollow cupola; κοῖλος, θόλος.

The genus *Cœlotholus* and the two following genera form together the subfamily Cœlotholida, the hollow tubes of which do not communicate by anastomosing branches, and therefore form no lattice-mantle, as in the following subfamily Cœloplegmida. Another important difference between these two subfamilies of Cœlographida is found in the arrangement of the main tubes and their connection with the rhinocanna. In all Cœlotholida a pair of divergent frontal styles arise from the truncate oral side of each galea, and are connected with the mouth of the rhinocanna by two lateral convergent paired frenula (right and left); whereas the characteristic odd nasal style, which in all Cœloplegmida arises from the sagittal apex of each galea and is connected with the mouth of the rhinocanna by an odd sagittal frenulum, is always wanting. The total number of long verticillate styles, which project over the outer surface of the fork-thicket, is eight in *Cœlotholus*, whilst it is twelve in *Cœlothauma*, and sixteen in *Cœlothamnus*. The two latter may be derived from *Cœlotholus*, as the common ancestral genus of this subfamily.

1. *Cœlotholus octonus*, n. sp. (Pl. 122, figs. 1, 2).

Eight styles of equal length, regularly zig-zag, twice as long (in their free part) as the diameter of the loose fork-thicket. Anchor-pencils gradually tapering from the proximal towards the distal end. Each of the four primary frontal tubes (to the right and left of each valve) is simply forked, and the pectoral (anterior) branch of each tube is so diametrically opposed to the tergal (posterior) tube of the other side, that they form together a double cross.

*Dimensions.*—Diameter of the whole body 12, of the fork-thicket 2·5.

*Habitat*—South-Eastern Pacific, Station 300, depth 1375 fathoms.

2. *Cœlotholus cruciatus*, n. sp.

Eight styles of equal length, straight, twice as long (in their free part) as the diameter of the dense fork-thicket. Anchor-pencils of about equal size throughout their whole length. Each of four primary frontal tubes is divided into two equal, widely divergent branches; the anterior branches of the right side are diametrically opposed to the posterior branches of the left side, so that all eight together form a double cross.

*Dimensions.*—Diameter of the whole body 20, of the fork-thicket 4·0.

*Habitat.*—South-Western Pacific (off Sydney), Station 164A, depth 1200 fathoms.

3. *Cœlotholus ancoratus*, n. sp.

Eight styles of different lengths, slightly curved. Anchor-pencils gradually tapering from the proximal to the distal end. Each of the four primary frontal tubes is divided into two divergent

branches of different lengths; the anterior (or pectoral branch) twice as long (in the free part) as the diameter of the fork-thicket, the posterior (or tergal branch) three times as long.

*Dimensions.*—Diameter of the whole body 20, of the fork-thicket 3·2.

*Habitat.*—Indian Ocean (Sunda Strait), Rabbe, surface.

Genus 732. *Cœlothauma*,[1] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Cœlographida with two paired lateral frenula on each galea, without external lattice-mantle, armed with twelve styles (three pairs of styles on each valve).

The genus *Cœlothauma* differs from the preceding *Cœlotholus*, its ancestral form, in the possession of twelve long, prominent styles, six of which are opposite in three pairs on each valve. In the single species observed each of the four main tubes (opposite in pairs on the frontal corners of the two galeæ) is simply forked, as in *Cœlotholus;* but whilst in this latter all eight styles remain simple, in *Cœlothauma* the anterior (or pectoral) branch only is simple, the posterior (or tergal) branch is again forked.

1. *Cœlothauma duodenum*, n. sp. (Pl. 122, figs. 3–5).

Twelve styles straight, of different lengths. Two short bilateral main tubes arise opposite in pairs from the two frontal corners of each galea, and are divided into an anterior and posterior branch. The anterior or pectoral branch is simple, and twice as long as the diameter of the fork-thicket. The posterior or tergal branch is again forked near the base, and its two divergent branches are three times as long as the diameter of the fork-thicket. All twelve styles are densely studded with anchor-pencils of nearly equal size.

*Dimensions.*—Diameter of the whole body 21, of the fork thicket 3·5.

*Habitat.*—South-Western Pacific (east of New Zealand), Station 169, depth 700 fathoms.

Genus 733. *Cœlothamnus*,[2] Haeckel, 1879, Sitzungsb. med.-nat. Gesellsch. Jena, Dec. 12, p. 6.

*Definition.*—Cœlographida with two paired lateral frenula on each galea, without external lattice-mantle, armed with sixteen styles (four pairs of styles on each valve).

The genus *Cœlothamnus* differs from its ancestral form, *Cœlotholus*, in the duplication of the number of long verticillate styles, which are prominent over the surface of the

[1] *Cœlothauma* = Hollow wonder; κοῖλος, θαῦμα.

[2] *Cœlothamnus* = Hollow thicket; κοῖλος, θάμνος.

dense fork-thicket. Whilst in *Cœlotholus* each frontal main tube (arising from the frontal corner of the galea at right and left) is divided into an anterior or pectoral, and a posterior or tergal style, in *Cœlothamnus* each of these two divergent main styles is again forked, so that the total number of projecting and radially diverging styles amounts to sixteen. One Mediterranean species of this genus, *Cœlothamnus davidoffii*, has been already described by Bütschli in 1882 (Zeitschr. f. wiss. Zool., vol. xxxvi. p. 486, Taf. xxxi.). Though its description on the whole is accurate, some important errors, which may be here corrected, are to be met with. The two central valves of the lattice-shell (dorsal and ventral) are symmetrically equal in size and in form, as in all other Cœlographida; the different forms and the inverse arrangement of the two valves, described by Bütschli (pp. 488, 491), were effected by an artificial dislocation and inversion. The peculiar opening $\alpha$, which, according to his opinion, was supposed to bring about a direct communication between the cavities of the galea and its valve, is in reality the optical section of the rhinocanna, the two convergent frenula of which ($\gamma$) he figured, but did not recognise. *Cœlothamnus* attains the greatest size among all Radiolaria; the diameter of the body in *Cœlothamnus maximus* amounts to 33 mm.

1. *Cœlothamnus bivalvis*, n. sp. (Pl. 122, figs. 6–9).

Sixteen styles all of equal length, about three times as long (in their free part) as the diameter of the dense fork-thicket. The size of the anchor-pencils tapers from the proximal to the distal end. Each of the four primary frontal tubes (which arise in opposite pairs from the frontal corners of the two galeæ) is twice forked, and so produces four styles.

*Dimensions.*—Diameter of the whole body 18, of the fork-thicket 2·4 to 3·0.

*Habitat.*—North Atlantic, Canary Islands, Station 354, surface.

2. *Cœlothamnus davidoffii*, Bütschli.

*Cœlothamnus davidoffii*, Bütschli, 1882, Zeitschr. f. wiss. Zool., vol. xxxvi. p. 486, Taf. xxxi.

Sixteen styles all of equal length (?), about four times as long (in their free part) as the diameter of the fork-thicket. The size of the anchor-pencils is nearly equal throughout their entire length. (Compare the careful description of this species by Bütschli.)

*Dimensions.*—Diameter of the whole body 15, of the fork-thicket 1·8.

*Habitat.*—Mediterranean (Villafranca, near Nice), Davidoff, surface.

3. *Cœlothamnus sedecimalis*, n. sp.

Sixteen styles straight, of different sizes. The pectoral or anterior branch of each frontal main tube is simple, and twice as long as the diameter of the large fork-thicket. The tergal or posterior branch is forked at the base, and its anterior branch is again forked in the middle part, so that three

long divergent styles arise from each tergal tube. The hindermost of these is the longest, three times as long as the diameter of the fork-thicket. All anchor-pencils have nearly equal size.

*Dimensions.*—Diameter of the whole body 22, of the fork-thicket 5·2.

*Habitat.*—South Pacific, Station 166 (west of New Zealand), depth 275 fathoms.

4. *Cœlothamnus maximus*, n. sp.

Sixteen styles straight, of different sizes. The four frontal main tubes are already forked at the base, so that from each frontal corner of the two galeæ two divergent tubes, an anterior or pectoral and a posterior or tergal, arise. Each of these is again forked, and each branch prolonged into a very long verticillate style. The hindermost style of each side is the longest, twice as long as the foremost, and one and a half times as long as the two intermediate styles. The size of the anchor-pencils decreases in the distal third of the styles.

*Dimensions.*—Diameter of the whole body 32, of the fork-thicket 7·5.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

## Subfamily 2. Cœloplegmida, Haeckel.

*Definition.*—Cœlographida with an odd sagittal frenulum on each galea, and with an external bivalved lattice-mantle, produced by the anastomosing branches of the hollow radial tubes. Six to sixteen long styles are prominent over the surface of the mantle, and bear terminal coronets.

### Genus 734. *Cœlographis*,[1] n. gen.

*Definition.*—Cœlographida with an odd sagittal frenulum on each galea and an outer lattice-mantle, armed with six styles (one odd and two paired styles on each valve).

The genus *Cœlographis* is the simplest form of the Cœloplegmida, or of those Cœlographida in which the branches of the arborescent tubes are united on the surface of the calymma, and form a delicate bivalved lattice-mantle. In all these Cœloplegmida an odd nasal main style is developed on the apex of the galea, and this is connected by an odd sagittal frenulum with the mouth of the rhinocanna. *Cœlographis* differs from the other Cœlographida in the minimum number of coronal styles, viz., three on each valve, an odd anterior (nasal) and two paired posterior (tergal).

1. *Cœlographis regina*, n. sp. (Pl. 126, figs. 1*a*–1*d*).

Shell-mantle twice as long as broad, its frontal perimeter isosceles triangular, with a triangular excision at the base, its sagittal perimeter slenderly ovate. Nasal odd style twice as long as the

[1] *Cœlographis* = Hollow style; κοῖλος, γραφίς.

paired tergal styles, the former with ten to twelve, the latter with five to six alternate-cruciate pairs of lateral branches. Terminal coronets (on the free distal ends of the styles) palmate, with ten to twelve spinulate, irregular, finger-shaped branches (fig. 1*d*).

*Dimensions.*—Length of the shell 5·5, breadth 2·7.

*Habitat.*—South-Eastern Pacific (off Juan Fernandez), Station 297, depth 1775 fathoms.

### 2. *Cœlographis sagittella*, n. sp.

Shell-mantle one and a half times as long as broad, its frontal perimeter arrow-shaped, isosceles triangular, with a deep concave excision at the base, its sagittal perimeter slenderly ovate. Nasal odd style one and a half times as long as the paired tergal styles, the former with fourteen to sixteen, the latter with eight to nine verticils of branches. Terminal coronets three times forked, with eight subregular, broad and spinulate, finger-shaped branches.

*Dimensions.*—Length of the shell 6·4, breadth 4·2.

*Habitat.*—Central Pacific, Station 271, depth 2425 fathoms.

### 3. *Cœlographis hexastyla*, n. sp.

Shell-mantle one and a half times as long as broad, very similar to the preceding species, its frontal perimeter isosceles triangular, with a flat basal excision. Nasal odd style one and a third times as long as the paired tergal styles, the former with fourteen to sixteen, the latter with ten to twelve verticils of branches. Terminal coronets with four forks in the form of a cross, and eight divergent spinulate fingers.

*Dimensions.*—Length of the shell 4·2, breadth 3·1.

*Habitat.*—North Pacific, Station 259, depth 2225 fathoms.

### 4. *Cœlographis gracillima*, Haeckel.

*Cœlodendrum gracillimum* (*partim*) Haeckel, 1862, Monogr. d. Radiol., Taf. xxxii. figs. 2, 3.

Shell-mantle one and a third times as long as broad, similar to the three preceding species, its frontal perimeter isosceles triangular. Nasal odd style one and a half times as long as the two paired tergal styles, the former with eleven or twelve, the latter with seven or eight pairs of branches. Terminal coronets irregularly dichotomously branched, with twelve to sixteen spinulate fingers. The network of the mantle is also spinulate (*loc. cit.*, fig. 3). This species was formerly confounded by me with *Cœlodendrum gracillimum* (*loc. cit.*, fig. 1), since I found a fragment only of the former entangled in the branch-work of the latter (1859, in Messina). Afterwards (in 1877) I observed a complete specimen in Corfu.

*Dimensions.*—Length of the shell 3·2, breadth 2·4.

*Habitat.*—Mediterranean (Messina, Corfu), surface.

### 5. *Cœlographis triangulum*, n. sp.

Shell-mantle about as long as broad, its frontal perimeter equilateral triangular, without basal excision, with three equal straight sides. Nasal odd style and the two paired pectoral styles nearly

of equal length, each with ten to twelve alternate-cruciate pairs of lateral branches. Terminal coronets umbrella-shaped, composed of eight equal, simply forked branches.

*Dimensions.*—Length of the shell 3·6, breadth 3·4.

*Habitat.*—South Pacific, Station 293, depth 2025 fathoms.

## Genus 735. *Cœlospathis*,[1] n. gen.

*Definition.*—Cœlographida with an odd sagittal frenulum on each galea and an outer lattice-mantle, armed with eight styles (two odd and two paired styles on each valve).

The genus *Cœlospathis* differs from the preceding *Cœlographis* in the possession of four coronal styles on each valve. Two of these are odd and lie in the sagittal plane, viz., the constant vertical nasal style (directed towards the mouth), and the horizontal sagittal style, which is placed in the equatorial plane, in the sagittal axis of the body. The two other styles are paired and identical with the tergal styles of *Cœlographis*, directed backwards, and divergent to right and left.

### 1. *Cœlospathis ancorata*, n. sp. (Pl. 128, figs. 1–7).

Shell-mantle one and a half times as long as broad, its frontal perimeter isosceles triangular; its zonal perimeter square, its sagittal perimeter nearly rectangular, with a concave excision on the oral side (fig. 1). Odd nasal styles of both valves divergent in the sagittal plane (each with fourteen to sixteen pairs of branches), three times as long as the odd sagittal styles (each with three or four pairs) and twice as long as the paired tergal styles (each with four to six pairs of branches). Terminal coronets (on the free distal end of the styles) three times forked, each with eight slender, widely divergent fingers, which are curved, zig-zag, and armed with alternating recurved hooks; at the end of each finger a verticil of four to six small recurved teeth (fig. 5).

*Dimensions.*—Length of the shell 2 to 3, breadth 1·2 to 2·1.

*Habitat.*—South Pacific, Station 289, depth 2550 fathoms.

### 2. *Cœlospathis octostyla*, n. sp. (Pl. 128, fig. 8).

Shell-mantle one and a third times as long as broad, very similar to the preceding species; but differing from this in the following characters: the odd nasal styles bear ten to twelve pairs of branches, and are twice as long as the odd sagittal and the paired pectoral styles, which are nearly equal in size (each with five or six pairs of branches). The eight fingers of the terminal coronets are less divergent and curved than in the preceding species, and each finger bears at its end a verticil of four to six divergent, slender teeth, which are not recurved (fig. 8).

*Dimensions.*—Length of the shell 2·2 to 2·6, breadth 1·7 to 1·9.

*Habitat.*—Central Pacific, Stations 271 to 274, depth 2350 to 2750 fathoms.

[1] *Cœlospathis*=Hollow whorl; κοῖλος, σπαθίς.

3. *Cœlospathis octodactyla*, n. sp. (Pl. 128, fig. 9).

Shell-mantle about as long as broad, in the frontal perimeter nearly isosceles triangular, very similar to the two preceding species; it differs from them in the following characters: all eight styles have nearly equal size, and each bears six to eight pairs of branches. The eight fingers of the terminal coronets diverge nearly in one plane, and are not curved in a zigzag manner, but armed with alternate, slender, recurved hooks, which are larger than in the two preceding species, and geniculate at the base; the distal end of each finger bears a verticil of eight to ten very small divergent teeth, which are not recurved (fig. 9).

*Dimensions.*—Length of the shell 2·4, breadth 2·2.

*Habitat.*—North Pacific, Station 252, surface.

## Genus 736. *Cœlodecas*,[1] n. gen.

*Definition.*—Cœlographida with an odd sagittal frenulum on each galea and an outer lattice-mantle, armed with ten styles (one odd and four paired styles on each valve).

The genus *Cœlodecas* is closely allied to *Cœlographis*, but differs from it in the development of a new pair of styles on each valve. These are placed between the odd nasal and the paired tergal styles, are usually directed laterally, parallel to the frontal axis of the body, and may therefore be called frontal or lateral styles. The total number of coronal styles is therefore ten.

1. *Cœlodecas sagittaria*, n. sp. (Pl. 126, figs. 2*a*, 2*b*).

Shell-mantle one and a half times as long as broad; its frontal perimeter pentagonal, with a deep median incision at the base; the two oral-sides of the pentagon twice as long as the two lateral sides, and one and a half times as long as the base. Sagittal perimeter ovate; equatorial perimeter subcircular. Nasal odd style of each valve with fourteen to sixteen pairs of branches, one and a half times as long as the paired frontal styles (each with eight to nine pairs), and twice as long as the paired tergal styles (each with four to six pairs of branches). Terminal coronets (on the free distal ends of the styles) richly branched, each with thirty to forty thorny fingers, which bear a conical point with recurved teeth, like an arrow.

*Dimensions.*—Length of the shell 3·2, breadth 2·1.

*Habitat.*—Tropical Atlantic, Station 347, depth 2250 fathoms.

3. *Cœlodecas decastyla*, n. sp.

Shell-mantle one and a third times as long as broad; its frontal perimeter pentagonal, with a slight incision on the base; the two oral sides of the pentagon as long as the base, and one and a

[1] *Cœlodecas*=Shell with ten hollow styles; κοῖλος, δεκάς.

half times as long as the two lateral sides. Nasal odd style of each valve with ten to twelve pairs of branches, about twice as long as the four paired frontal and tergal styles, each of which bears five or six pairs. Terminal coronets three times forked, each with eight straight, spinulate, slightly divergent fingers, shaped like a human finger.

*Dimensions.*—Length of the shell 3·6, breadth 2·7.

*Habitat.*—Central Pacific, Station 272, depth 2600 fathoms.

3. *Cœlodecas pentagona*, n. sp.

Shell-mantle about as long as broad; its frontal perimeter nearly regular pentagonal, with five equal sides. Nasal odd style of each valve with six to eight pairs of branches scarcely longer than the four paired frontal and tergal styles, each of which is provided with four to six pairs. Terminal coronets irregularly branched, each with twelve to sixteen slender curved fingers, which bear at the distal end a spinulate knob.

*Dimensions.*—Length of the shell 2·6, breadth 2·4.

*Habitat.*—South Atlantic, Station 332, depth 2200 fathoms.

## Genus 737. *Cœlostylus*,[1] n. gen.

*Definition.*—Cœlographida with an odd sagittal frenulum on each galea and an outer lattice-mantle, armed with twelve styles (two odd and four paired styles on each valve).

The genus *Cœlostylus* is characterised by the possession of twelve coronal styles; it is closely allied to *Cœlospathis*, and differs from this in the development of a new pair of styles on each valve. These are placed between the odd nasal and the odd sagittal style of each valve, they are directed forwards, and may therefore be called "pectoral styles."

1. *Cœlostylus bisenarius*, n. sp. (Pl. 126, fig. 3*a*, 3*b*).

Shell-mantle one and a third times as long as broad; its frontal perimeter pentagonal, with a deep median incision at the base; the two oral sides of the pentagon about as long as the basal odd side, and half as long as the two lateral sides. Sagittal perimeter (fig. 3*a*) octagonal; the three paired lateral sides of the bilateral octagon about equal, and somewhat shorter than the basal and oral odd sides. Equatorial perimeter rounded square. Nasal odd style of each valve with twelve alternate-cruciate pairs of lateral branches, about twice as long as the two paired pectoral styles (each with four pairs), and the odd sagittal style (with six pairs); the two paired tergal styles bear eight pairs and are longer than the latter, shorter than the nasal style. All styles are more or less curved, divergent, and at the distal end four times forked, bearing a terminal coronet with sixteen spinulate fingers (fig. 3*b*).

*Dimensions.*—Length of the shell 4·2, breadth 3·2.

*Habitat.*—Indian Ocean (Madagascar), Rabbe, surface.

[1] *Cœlostylus* = Hollow style; κοῖλος, στύλος.

2. *Cœlostylus flabellatus*, n. sp.

Shell-mantle one and a half times as long as broad, very similar to that of the preceding species. It differs from this mainly in the peculiar form of the twenty-four terminal coronets, which are flabellate and very similar to the terminal branches of *Cœlodendrum flabellatum* (Pl. **121**, figs. 5, 6). I formerly supposed, therefore, that both forms belonged to one and the same species. But though I had no complete specimens of the two species, I was afterwards led to the opinion that one and the same peculiar form of terminal branches is here produced by adaptation to similar conditions in two very different genera. Each coronet is a flat flabellum, placed in a meridian plane, and composed of eight pairs of spinulate branches as figured, *loc. cit.*, in figs. 5 and 6. The cap-shaped distal end of each finger is armed with eight to twelve recurved teeth.

*Dimensions.*—Length of the shell 3·8, breadth 2·6.

*Habitat.*—North Pacific, Station 252, surface.

## Genus 738. *Cœloplegma*,[1] n. gen.

*Definition.*—Cœlographida with an odd frenulum on each galea and an outer lattice-mantle, armed with fourteen styles (one odd and six paired styles on each valve).

The genus *Cœloplegma*, distinguished by the possession of fourteen coronal styles, is closely allied to *Cœlodecas*, but differs from it in the development of a new pair of styles on each valve. These are placed between the odd nasal and the paired frontal styles, are directed forwards, and may therefore be called pectoral styles, corresponding to those of *Cœlostylus*.

1. *Cœloplegma murrayanum*, n. sp. (Pl. **127**, fig. 1).

Shell-mantle about as long as broad, its frontal perimeter subcircular, or slightly pentagonal, with five convex sides, its sagittal perimeter also nearly circular. Odd nasal style with six to eight, the paired pectoral styles with two or three, lateral styles with three to five, and tergal styles with six to nine pairs of branches. The central capsule constantly contains masses of crystals (figs. 4–7). Terminal coronets (on the free distal ends of the styles) three times furcate, each with eight simple and short fingers. This interesting species, discovered by Dr. John Murray in August 1882, during the expedition of H.M.S. "Triton," in great numbers in the Gulf Stream, off the Færöe Channel, is very variable and connected by numerous transitional forms with the following closely allied species. (Compare the following note.)

*Dimensions.*—Length of the shell 1·6 to 2·2, breadth 1·5 to 2·1.

*Habitat.*—North Atlantic, Gulf Stream, off the Færöe Channel, in depths between 40 and 200 fathoms, John Murray.

[1] *Cœloplegma*=Hollow framework ; κοῖλος, πλέγμα.

2. *Cœloplegma tritonis*, n. sp. (Pl. **127**, figs. 2–13).

Shell-mantle one and a quarter times as long as broad, its frontal perimeter heptagonal, with seven concave sides (fig. 2), its sagittal perimeter ovate, its zonal perimeter nearly square (fig. 3). Odd nasal style with twelve to fourteen, the paired pectoral styles with three to four, lateral styles with six to eight, and tergal styles with eight to ten pairs of branches. Coronets three times forked, each with eight terminal branches, bearing a small spinulate knob. This remarkable species, in external appearance very different from the preceding, is connected immediately with it by numerous transitional varieties; both species represent the opposite terminal poles of a long series of "Darwinian metamorphic forms." If only the two specimens, figured in Pl. **127**, figs. 1 and 2, were known, every one would distinguish them as two widely different species. But the careful comparison of numerous intermediate forms demonstrates that there is no "missing link" in this long and remarkable chain. The careful comparative study of these very variable and most highly developed Cœlographida may be regarded as a strong argument for the theory of descent, and explains the true "origin of species."

*Dimensions.*—Length of the shell 1·8 to 2·5, breadth 1·5 to 2·1.

*Habitat.*—North Atlantic, Gulf Stream, off the Færöe Channel, in depths between 40 and 200 fathoms, John Murray.

3. *Cœloplegma tetradecastylum*, n. sp.

Shell-mantle one and a third times as long as broad, its frontal perimeter heptagonal, with seven concave sides. Similar to the preceding species, differs from it mainly in the prolonged nasal style, which bears sixteen to eighteen pairs of branches, and is about three times as long as each of the six paired styles, each of which bears five to six pairs of branches. Coronets three times forked, each with eight terminal branches, armed with scattered spines, and bearing a knob with three recurved hooks.

*Dimensions.*—Length of the shell 3·2, breadth 2·4.

*Habitat.*—Tropical Atlantic, Stations 335 to 342, surface.

4. *Cœloplegma atlanticum*, n. sp.

Shell-mantle one and a half times as long as broad, its frontal perimeter ovate. Similar to *Cœloplegma murrayanum* (Pl. **127**, fig. 1), differs from it in the different length of the styles; the nasal odd style (with eighteen to twenty pairs of branches) is about twice as long as the lateral styles (with ten to twelve pairs), and three times as long as the pectoral and tergal styles (with six to eight pairs). Coronets four times forked, each with sixteen terminal branches, armed with recurved spines, and bearing a cross of four curved hooks.

*Dimensions.*—Length of the shell 2·5, breadth 1·7.

*Habitat.*—South Atlantic, Station 318, depth 2040 fathoms.

Genus 739. *Cœlagalma*,[1] n. gen.

*Definition.*—Cœlographida with an odd sagittal frenulum on each galea and an outer lattice-mantle, armed with sixteen styles (two odd and six paired styles on each valve).

The genus *Cœlagalma* represents the highest degree of development among the Cœlographida, and exhibits the maximum number of coronal styles in this family, viz., sixteen (eight on each valve). Two of these are odd (as in *Cœlospathis* and *Cœlostylus*), viz., the longitudinal anterior nasal style, and the horizontal sagittal style. The six others are paired (as in *Cœloplegma*), viz., two anterior or pectoral, two lateral or frontal, and two posterior or tergal styles. Since *Cœlagalma* in this highest developed armature exceeds all the other Cœloplegmida, and exhibits at the same time the utmost complexity in structural detail, it may be regarded as one of the most perfect forms not among the PHÆODARIA only, but among all Radiolaria.

1. *Cœlagalma mirabile*, n. sp. (Pl 126, figs. 4*a*, 4*b*).

Shell-mantle one and a half times as long as broad, its frontal perimeter (fig. 4*a*) heptagonal, with seven concave sides, its sagittal perimeter octagonal, its equatorial perimeter hexagonal (fig. 4*b*), the corners of the polygons are marked by the sixteen prominent styles. Nasal odd style longer; and sagittal odd style shorter, than the six paired styles of each valve; the two pectoral styles are directed forwards, the two lateral styles are nearly opposed in the horizontal frontal diameter, while the two shorter tergal styles are directed backwards. The terminal coronets (at the distal ends of the sixteen styles) are four times forked, with sixteen equal spinulate fingers, each finger at the distal end with eight recurved teeth. The entire surface of the bivalved latticed mantle is densely studded with hundreds of most elegant anchor-pencils, so that the external appearance of this beautiful species becomes one of the most wonderful among Radiolaria.

*Dimensions.*—Length of the shell 5·4, breadth 3·6.

*Habitat.*—Central area of the Pacific, Station 271, depth 2425 fathoms.

[1] *Cœlagalma* = Hollow ornament; κοῖλος, ἄγαλμα.

## NOTE ON THE DIMENSIONS AND MEASUREMENTS OF THE DESCRIBED SPECIES OF RADIOLARIA.

All the dimensions of the species of Radiolaria described in the present work are given in millimetres. In the majority of the species the dimensions of only a single observed specimen have been measured by the micrometer, and usually only the most important proportions have been recorded. But since the outlines of nearly all the species figured (with very few exceptions) have been drawn by the camera lucida, and therefore usually are almost perfectly exact, and since the excellent artist, Mr. Adolph Giltsch, has executed the lithographic plates with the greatest accuracy, having examined the objects themselves under the microscope, it is very easy to determine the dimensions of all the separate parts by comparative measurement. In very many of the species described (perhaps nine hundred or a thousand) several specimens of each species (usually three or four) have been measured comparatively, and the dimensions recorded are taken as averages. A very important contribution to the general conception of the proportions, and especially to the important question of the constancy of the dimensions, has been given by my honoured friend, Dr. Reinhold Teuscher of Jena. This excellent observer, to whom I am indebted for much and important co-operation in my Radiolarian work, has instituted at my request a long series of measurements, with the view of comparing the dimensions (of the entire skeleton as well as of its individual parts) in numerous (usually twenty or thirty) specimens of one and the same species. About three hundred species of very different groups (mainly Sphæroidea, Discoidea, Spyroidea, and Cyrtoidea) have been measured in this manner, and the general survey of the results obtained (about eight thousand measurements were recorded) has enabled me to form a good opinion of the constancy and variability of the dimensions in the individual species. The general result is, that they are not absolutely constant in any given case, but that each species (of which many specimens have been carefully compared) exhibits a certain degree of variability in all its proportions. The general meaning of "species," therefore, is in the unicellular Radiolaria the same as in all other organisms, and its development follows the same laws as are so accurately explained by Charles Darwin in his Origin of Species.

# ADDENDA.

## I. *List of Twenty-two Deep-Sea Radiolarians from the Banda Sea.*

P. Harting (L. N. 18) published in 1863 the description of 14 SPUMELLARIA and 8 NASSELLARIA, taken in depths between 900 and 4000 fathoms, in the Banda Sea. The figures of them are, however, for the most part not complete enough. The names are the following :—

### I. SPUMELLARIA.

1. *Haliomma nitidum*, figs. 13, 14 = *Heliodiscus?*
2. *Haliomma gracile*, fig. 15 = *Acanthosphæra?*
3. *Haliomma lens*, fig. 16 = *Stylodiscus?*
4. *Haliomma pyriforme*, fig. 17 = *Cenellipsis?*
5. *Haliomma scutum*, fig. 18 = *Botryocella?*
6. *Haliomma polyacanthum*, fig. 40 = *Druppocarpus?*
7. *Haliomma inerme*, fig. 41 = *Thecosphæra?*
8. *Haliomma oblongum*, fig. 42 = *Druppula?*
9. *Haliomma amphiaspis*, fig. 43 = *Monozonium.*
10. *Tetrapyle polyacantha*, fig. 44 = *Larcarium?*
11. *Flustrella cyclica*, fig. 19 = *Porodiscus.*
12. *Flustrella micromma*, fig. 47 = *Porodiscus.*
13. *Rhopalastrum bandaicum*, fig. 45 = *Dictyastrum.*
14. *Lithocyclia reticulata*, fig. 20 = *Spongodiscus?*

### II. NASSELLARIA.

15. *Lithocircus annulus*, fig. 50 = *Lithocircus.*
16. *Acanthodesmia arcuata*, fig. 25 = *Zygostephanus.*
17. *Acanthodesmia inermis*, fig. 26 = *Dictyospyris?*
18. *Cladospyris moluccana*, fig. 48 = *Cyphonium?*
19. *Podocyrtis brevipes*, fig. 24 = *Podocyrtis.*
20. *Podocyrtis micracantha*, fig. 49 = *Podocampe?*
21. *Lithocampe corbula*, fig. 21 = *Lithomitra.*
22. *Lithocampe sinuosa*, fig. 22 = *Lithocampe?*

II. *List of Fossil Radiolaria (probably Jurassic) found in the "Diaspri della Toscana," and described in* 1880 *by Dante Pantanelli* (L. N. 36). (*Compare* § 243, *Note* B, p. clxviii).

The figures are too small and too incomplete for certain determination.

I. SPUMELLARIA.

1. *Ethmosphæra minuta.*
2. *Ethmosphæra vulgaris.*
3. *Ethmosphæra siphonophora.*
4. *Heliosphæra echinoidites.*
5. *Rhaphidococcus lusianensis.*
6. *Heliodiscus simplex.*
7. *Histiastrum lusianense.*
8. *Trematodiscus soritoides.*
9. *Euchitonia muellerites.*
10. *Euchitonia amœna.*
11. *Euchitonia clathrata.*
12. *Euchitonia crevolensis.*
13. *Euchitonia grandis.*
14. *Euchitonia dubia.*

II. NASSELLARIA.

15. *Lithocircus haeckelii.*
16. *Lithocircus truncatus.*
17. *Lithocircus rhombus.*
18. *Cornutella pseudoprofunda.*
19. *Cornutella pseudoclathrata.*
20. *Lithopera ovata.*
21. *Lithopera elongata.*
22. *Polystichia ehrenbergii.*
23. *Polystichia haeckelii.*
24. *Polystichia muelleri.*
25. *Urocyrtis emmæ.*
26. *Urocyrtis amaliæ.*
27. *Urocyrtis stephanii.*
28. *Adelocyrtis cometa.*
29. *Adelocyrtis pala.*
30. *Adelocyrtis spinosa.*

# ERRATA.

Page 23, line 3 from top, *add* "Compare also *Myxobrachia cienkowski*, Wagner, 1872, L. N. 23."

Page 40, bottom line, *add* "The two following species are incompletely known:—*Sphærozoum orientale*, Dana, 1863, *Ann. and Mag. Nat. Hist.*, vol. xii. p. 54. *Sphærozoum sanderi*, Dœnitz, 1871, L. N. 60, p. 71."

Page 65, line 15 from top, *add* "*Cenosphæra radiata*, Zittel, 1876 (L. N. 29, p. 84, Taf. ii. figs. 7, 8), a fossil Cretaceous species, is closely allied to *Cenosphæra compacta*."

Page 84, line 17 from top, *add* "*Caryosphæra polysphærica*, Bütschli, 1882 (L. N. 41, Taf. xxiii. fig. 12) is probably a *Cromyosphæra* (fossil in Barbados)."

Page 95, line 11 from top, *add* "*Dermatosphæra*, Ehrenberg, is a *Collosphæra* with small pores (compare L. N. 16, p. 533)."

Page 97, line 8 from foot, *for* "xxiv." *read* "xxxiv."

Page 122, line 14 from foot, *for* "*Spongolonche*" *read* "*Spongolonchis*."

Page 149, lines 1, 4, 6 and 12 from top, *for* "*Spongolonche*" *read* "*Spongolonchis*."

Page 149, line 2 from foot, *for* "*Spongolonche*" *read* "*Spongolonchis* (σπόγγος, λογχίς)."

Page 172, line 4 from foot, *add* Synonym "? *Haliphormis hexacantha*, Ehrenberg, 1872, L. N. 24, Taf. x. fig. 6."

Page 216, line 11 from foot, *add* "Taf. xiii."

Page 308, line 4 from top, *add* "Compare *Haliomma oblongum*, Harting, 1863, L. N. 18, p. 15, pl. 2, fig. 42.

Page 326, line 14 from foot, *for* "1872" *read* "1875."

Page 461, line 12 from foot, *delete* "H."

Page 463, line 10 from top, *add* "Indian Ocean, Cocos Islands, Rabbe."

Page 492, bottom line, *add* "*Porodiscus haeckelii* = *Trematodiscus haeckelii*, Bütschli, 1882, L. N. 41, Taf. xxiv. figs. 5*a*, 5*b*."

Page 509, bottom line, *add* "*Stylodictya haeckelii*, Zittel, 1876, L. N. 29, p. 85, Taf. ii. fig. 9, is a fossil Cretaceous species, related to *Stylodictya multispina*."

Page 534, line 11 from foot, *add* "Indian Ocean, Cocos Islands (Rabbe). Also in the Central Pacific, Station 267."

Page 584, line 12 from top, *for* "1872" *read* "1875."

Page 586, line 7 from foot, *add* "*Spongotrochus ehrenbergii*, Bütschli, 1882, L. N. 41, Taf. xxvi. figs. 1*a*, 1*b*."

Page 633, bottom line, *add* "*Monozonium hartingii* = *Haliomma amphiaspis*, Harting, 1863 (L. N. 18, p. 15, pl. 2, fig. 43)."

Page 763, line 8 from top, *add* "Pl. **132**, fig. 11."
Page 784, line 16 from top, *for* "vi." *read* "xvi."
Page 802, line 14 from bottom, *after* "11*a*" *insert* "11*c*."
Page 839, line 13 from top, *for* "**95**" *read* "**135**."
Page 841, line 8 from foot, *after* "figs." *insert* "2."
Page 842, line 13 from top, *add* "*Haliomma ligurinum*, J. Müller (= *Haliommatidium ligurinum*, Haeckel, L. N. 16, p. 423) seems to be closely allied to the preceding."
Page 889, line 6 from top, *add* "*Cricoidea*, Bütschli, 1882 (L. N. 40, p. 537) = NASSELLARIA."
Page 951, line 9 from foot, *add* "Fossil in Barbados."
Page 952, line 2 from foot, *add* "Fossil in Barbados."
Page 966, line 10 from top, *add* "Fossil in Barbados."
Page 981, line 19 from top, *add* "Fossil in Barbados."
Page 1037, line 8 from top, *add* "Pl. **85**, fig. 2."
Page 1081, line 12 from foot, *add* "Pl. **95**, fig. 15."
Page 1158, line 10 from foot, *for* "516. *Cyrtophormis*" *read* "516. *Cystophormis*."
Page 1165, lines 8, 11 and 15 from foot, *for* "*Cyrtophormis*" *read* "*Cystophormis*."
Page 1165, bottom line, *read* "*Cystophormis* = bladder-basket; κυστή, φορμίς."
Page 1166, lines 1, 7 and 13 from top, *for* "*Cyrtophormis*" *read* "*Cystophormis*."
Page 1250, line 7 from top, *for* "*Dictyoprora*" *read* "*Dictyoprona*."
Page 1251, line 11 from top, *add* "Pl. **62**, fig. 3."
Page 1356, line 9 from foot, *add* "Pl. **68**, fig. 14."
Page 1384, line 2 from foot, *for* "*Calocycloma*" *read* "*Calocyclura*."
Page 1411, first line, *add* "Pl. **68**, fig. 15."
Page 1560, line 2 from top, *add* "*Dictyocha trigona*, Zittel, 1876 (L. N. 29, p. 83, Taf. ii. fig. 6), is an interesting Cretaceous species, perhaps a variety of *Dictyocha triommata*."
Page 1615, line 6 from top, *insert* "n. sp." *after* "*scenophora*."
Page 1653, line 7 from top, *add* "John Murray, 1876, L. N. 27, pl. 24, fig. 2."
Page 1706, line 7 from foot, *add* "John Murray, 1876, L. N. 27, pl. 24, fig. 4."
Page 1752, line 4 from bottom, *for* "figs. 1*a*–1*d*" *read* "figs. 1*a*–1*c*."
Page 1757, line 14 from bottom, *for* "fig. 1" *read* "figs. 1–13."
Page 1759, line 14 from bottom *for* "figs. 4*a*, 4*b*" *read* "figs. 4, 4*a*.

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Synonyms are printed in *Italics*; names of Families, Orders, &c., in SMALL CAPITALS.


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